Aalto University
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Degree Programme in Computer Science and Engineering

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Mediated University-Industry Collaboration: A Case Study on Managerial Perceptions of Openness

Master's Thesis

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Abstract of master's thesis

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Abstract

University-industry (UI) collaboration is a key driver of innovation, which is vital for economic growth of regions and nations. The value of this collaboration has motivated the founding of a variety of organizations that mediate and ease this collaboration, called intermediary organizations.

As perceptions affect the decision making of individuals, understanding the perceptions of these key personnel provides understanding into how they make decisions regarding their collaboration. This thesis studies managerial perceptions of key personnel in UI-collaborations that are mediated by intermediary organizations.

The first phase of study probes what key personnel in mediated UI-collaboration perceive to be the success factors of their collaboration. The first phase results in four perceived key success factors: (1) Networks (2) Knowhow and experience, (3) Shared understanding of goals and processes, and (4) openness

Existing literature has noted the importance of intermediary organizations in UI-collaboration and the value of openness in the same context. However, there is little integrating research on how the managers of these organizations might perceive the key concept of openness. The second phase of this thesis consists of a publication that addresses this research gap, and suggests a framework for managers' perceptions of openness in the context of mediated university-industry collaboration. The framework suggests four main ways managers perceive openness.

The first way is to perceive openness as driven by managing the relationship, such as by investment in long-term collaboration. The second way suggests managers perceive openness as being driven by bringing people together, such as cherishing face-to-face meetings and building spaces where people can meet.

The third way suggests managers perceive openness as a driver of co-creation of knowledge. The fourth way suggests managers perceive that openness also supports other beneficial results of the collaboration, such as in a case where benefits of sharing ideas in a business incubator was perceived to outweigh the risks of the idea leaking out.

Keywords University-Industry Collaboration, Openness, Managerial Perceptions, Decision Making

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Tiivistelmä

Yliopistojen ja yritysten välinen yhteistyö on olemassa olevan kirjallisuuden perusteella voimakas tekijä innovaatioiden synnyssä, jolla on suuri vaikutus alueiden ja valtioiden taloudelliseen kasvuun. Tätä yhteistyötä tukemaan on perustettu lukuisia erilaisia välittäjäorganisaatioita, joiden toimenkuvana on helpottaa tätä yhteistyötä.

Käsitteet, joilla käsitteellistetään yritysten ja yliopistojen välistä yhteistyötä, ovat monimutkaisia, ja se, miten nämä konseptit mielletään, vaikuttaa päätöksentekoon tässä yhteistyössä. Tämä diplomityö tutkii näitä näkemyksiä sellaisessa yliopisto-yritys yhteistyössä jonka välittäjänä toimii jokin välittäjäorganisaatio.

Tutkimuksen **ensimmäinen osa** tutkii miten avainhenkilöt välittäjällisessä yliopistojen ja yritysten yhteistyössä näkevät yhteistyön onnistumiseen vaikuttavat tekijät. Ensimmäisen osan tuloksena tämä diplomityö esittelee neljä avaintekijää: (1) Verkostot, (2) Tietotaito, (3) Jaettu ymmärrys tavoitteista ja prosessista sekä (4) Avoimuus.

Aiempi kirjallisuus on tunnustanut välittäjäorganisaatioiden merkityksen yliopistojen ja yritysten välisessä yhteistyössä, sekä avoimuuden merkityksen samassa kontekstissa. Sitä, kuinka näiden välittäjäorganisaatioiden johtohenkilöt mieltävät avoimuuden, ei kuitenkaan ole juuri tutkittu. Tämän diplomityön **toinen osa** koostuu julkaisusta joka pyrkii täyttämään tätä aukkoa tieteellisessä keskustelussa. Julkaisu esittelee aihion, joka esittelee neljä tapaa joilla välittäjäorganisaatioiden johtohenkilöt näkevät avoimuuden kontekstissaan

.

Aihion kaksi ensimmäistä näkemystä ovat näkemyksiä avoimuuteen johtavista asioista, kaksi jälkimmäistä ovat näkemyksiä asioista joihin avoimuus johtaa. Ensimmäinen näkemys on, että tavat joilla yhteistyötä johdetaan, vaikuttavat avoimuuteen, esimerkiksi investointi pitkäaikaiseen yhteistyöhön. Toinen näkemys on, että avoimuutta voidaan kannustaa tuomalla ihmiset yhteen, kuten järjestämällä tiloja joissa yhteistyön osapuolet voivat tavata. Kolmas näkemys on, että välittäjäorganisaatioiden johtohenkilöt näkevät avoimuuden johtavan tiedon yhdessä luomiseen. Neljäs näkemys on, että avoimuus tukee myös yhteistyön muita hyödyllisiä tuloksia, kuten tapauksessa jossa liikeideoiden jakamisen hyödyt yrityshautomossa nähtiin olevan idean vuotamisen riskiä suurempi tekijä.

Avainsanat Yliopisto-yritys yhteistyö, Avoimuus, Näkemykset, Päätöksenteko

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It was a long trip, but I didn't really hurry. I stopped along the way, met awesome people, and enjoyed the ride.

I spent three years as a research assistant in SimLab. Even when I did everything in the wrong order (working there while studying the pre-requisite courses, publishing before writing a thesis etc.), no one in SimLab tried to stop me. Quite the opposite, SimLab was very supportive and flexible, letting me do things the way I like. And it was awesome.

Of course, for me SimLab is not the building nor the organization, SimLab means the people inside. Thanks to Professor Riitta Smeds for all the support, and Mirje Halla for honest and fluent collaboration during the publication, and Saara Matala for always kicking me back to work.

Very special thanks to my instructor Pauli Alin for his remarkable patience in guiding my work and teaching me how to do Science. It was not once or twice during the process that I walked into a meeting to get a review on the progress of the publication, feeling there was no way I would be able to make it work. And every time I walked out of the meeting feeling a spark of hope all of this might actually lead to something.

Thank you to my friends both in Oulu and the capital area. I don't think there have been many (or any?) days during my studies I hadn't talked to at least one of you. Thank you to Teekkarispeksi for teaching me to be express myself and to not mind looking stupid while doing it.

And of course, thank you to my family: Mom, Dad, and Tuomo. Even when there can be months between visits, it's always relaxing to come to Oulu. And sorry Grandma, seems like we got yet another Master of Science in the family after all.

Espoo, June 1st 2015

Heikki Moilanen

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Publication

This master's thesis consists of a thesis body and the following publication:

Moilanen, H., Halla, M., Alin, P., (Forthcoming). Openness in University-Industry Collaboration: Probing Managerial Perceptions. *European Journal of Innovation Management.* Doi: 10.1108/EJIM-05-2013-0048

This publication is referenced to throughout the thesis as "the Publication".

Author's Contribution

Writing the Publication included a significant amount of collaboration and all parts were reviewed and have input by all authors. Data collection and data analysis were done in collaboration by the author of this thesis and Mirje Halla. Both the author of this thesis and Mirje Halla were present in interviews that form the data set of the Publication.

The author of this thesis had a leading role in forming a theoretical background, forming results from the data coding efforts and writing the article. Discussion and conclusions have input from all authors and are written by the author of this thesis.

Pauli Alin mentored, reviewed and gave input to all parts of the writing process except for data collection. Pauli Alin had a major role in writing a section on literature on managerial perceptions, which was reviewed Mirje Halla and the author of this thesis. Formulating the findings into a proposed framework was initiated by Pauli Alin and forming the framework was carried out by the author of this thesis.

INTRODUCTION

1 Introduction

This thesis studies managerial perceptions of success factors of mediated university-industry (UI) collaboration. It probes what managers involved in mediated UI-collaboration perceive to contribute to the success of their collaboration. In addition to what factors are perceived to contribute to success, it also probes how these factors are perceived. The data is collected from semi-structured interviews of key people involved in different types of mediated UI-collaboration in the capital area of Finland and analyzed by observing how they talk about their collaboration during in-depth interviews.

Open innovation is a new trend in innovation strategy used by firms all around the world. It emphasizes the importance of extending the firms' innovation strategy outside the firm boundaries – into collaborative partners such as universities. This 10-year-old trend in innovation strategy motivates a need for research on university-industry collaboration. However, collaboration between universities and firms is challenging and involves rather complex factors of success. Due to the difficulty of collaboration between these two rather different worlds, a variety of different intermediary organizations have emerged – organizations that assist this challenging collaboration such as partnership programs or university-led business incubators.

Since UI-collaboration has been recognized in existing literature as vital to the competitiveness of firms, regions and nations, the need to understand the success factors of this collaboration is also becoming more and more vital. Furthermore, as organizations mediating this collaboration have been seen to have a highly positive impact, the context where UI-collaboration is mediated by an intermediary organization is a very rewarding context for research.

This thesis presents a study involving two phases. The first phase explores what key personnel in mediated UI-collaboration perceive to be the success factors of their collaboration (figure 1). The theoretical background for this phase is presented in chapter 2, methods and data in chapter 3, findings in chapter 4 and discussion in chapter 5.

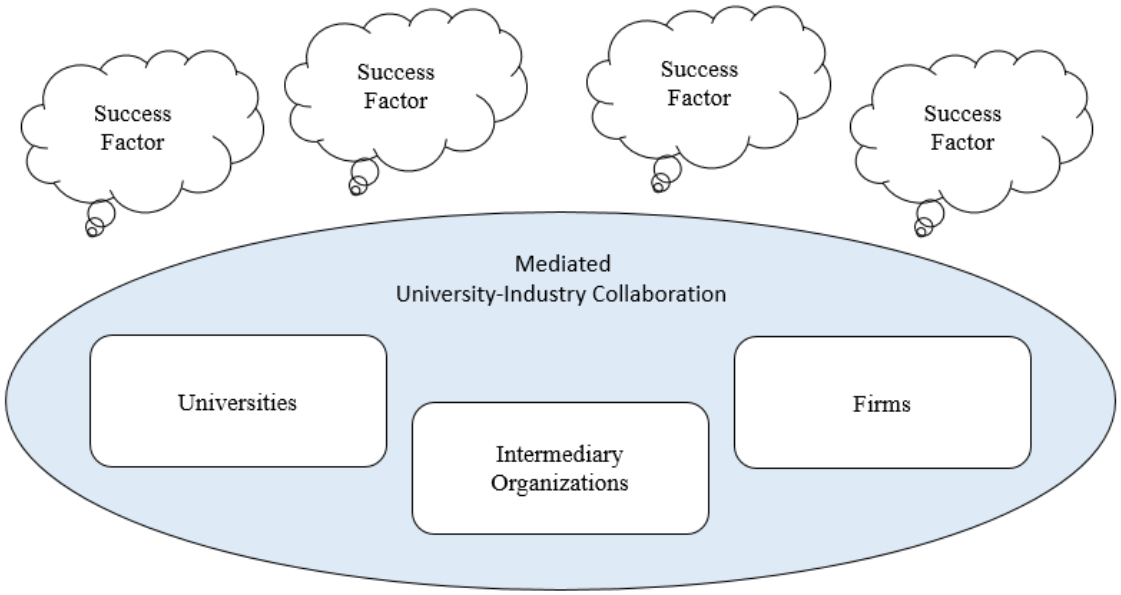

Figure 1: The first phase of the study: perceptions of success factors of UI-collaboration

The second phase builds on the first phase and existing literature and probes *how* managers in mediated UI-collaboration perceive one of these success factors: openness (Figure 2). It utilizes a smaller dataset, including only intermediary organizations' managers' perceptions. The second phase is linked to the first phase by focusing deeper into one of the findings of the first phase. The second phase of study is presented in a publication that is forthcoming in European Journal of Innovation Management and is included in this thesis.

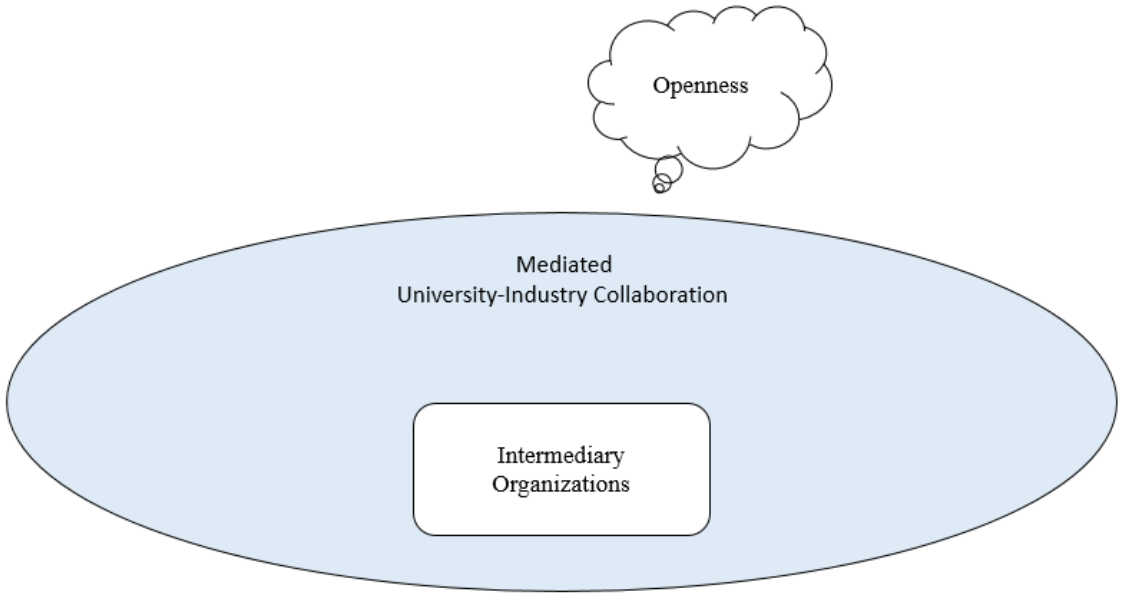

Figure 2: The second phase of the study: Intermediary organizations' managers' perceptions of openness

The goal of this thesis is to contribute to theoretical discussion of openness by opening the black box of "managerial perceptions of openness" by probing it in the context of

mediated UI-collaboration. This thesis also aims to have an impact to practice by inspiring those involved in UI-collaboration in their decision-making related to success factors and openness in their collaboration. This inspiration is conveyed through providing them with means to identify and understand the role of frequently perceived success factors of mediated university-industry collaboration, especially openness, in their decision making.

1.1 Background and motivation

University-industry collaboration as a part of firms' innovation strategies has been on the rise following the open innovation paradigm initiated by Chesbrough in 2003 (Chesbrough, 2012). The Publication included in this thesis presents background and motivation of the study presented this thesis in the following way:

"New knowledge creation is a key antecedent of innovation, which is a key driver of economic growth of nations and regions (Agrawal, 2001; Dossou-Yovo and Tremblay, 2012; Hine et al., 2010). Researchers have argued that university-industry collaboration is a powerful mechanism for new knowledge creation (Bercovitz and Feldman, 2007; Bishop et al., 2011; D'Este and Patel, 2007; Yusuf, 2008). University-industry collaboration refers to collaboration between universities and firms that is intended to generate and/or diffuse innovations. University-industry collaboration tends to include a two-way flow of knowledge, as both parties can be interested the knowledge the other (Meyer-Krahmer and Schmoch, 1998)".

"*In the context of university-industry collaboration, knowledge creation can be promoted by designating specific organizations to mediate the collaboration (Etzkowitz and Leydesdorff, 2000; Yusuf, 2008). Building on a long tradition of research on networks (e.g. Argote and Ingram, 2000; Zucker et al., 1988), researchers have identified that such intermediary organizations in university-industry collaboration can increase new knowledge creation by facilitating the collaboration among the participating individuals and organizations (Wright et al., 2008; Yusuf, 2008)*" (the Publication).

The positive effect of intermediary organizations to university-industry collaboration and the importance of university-industry collaboration to innovation motivate the first research question of this thesis.

> *First Research Question: What do key personnel in mediated university-industry collaboration perceive as key success factors of their collaboration?*

The research in this thesis is further motivated in the Publication in the following way:

"In addition to the role of intermediary organizations (Yusuf, 2008), researchers have acknowledged the importance of openness of the relationships among participants in university-industry collaboration (Fontana et al., 2006). Fontana et al. (2006) define openness as "the broad set of activities that firms can conduct to acquire knowledge from, voluntarily disclose knowledge to and/or exchange knowledge with the external world".

"Despite the importance of openness in university-industry collaboration and the importance of intermediary organizations in that same context, there appears to be little research indicating how managers in mediated university-industry collaboration might perceive the concept of openness. This lack of research is understandable given that it is difficult to collect data on managerial perceptions (Starbuck and Mezias, 1996). At the same time, the lack of research is problematic: because individuals make decisions based on their perceptions (Miles and Snow, 1986), the way in which intermediary organizations' managers and other personnel perceive the concept of openness impacts how they make decisions about it." (The Publication) The Publication included as a part of this thesis addresses this lack of research by probing how intermediary organizations' managers perceive the concept of openness in the specific context of university-industry collaboration.

> *Second Research Question: How do managers of intermediary organizations in university-industry collaboration perceive openness?*

1.2 Context of the study

This thesis studies collaboration specifically in the context where at least one partner of a collaboration is a firm and at least one partner is a higher education institution, e.g. a university. Further narrowing down the scope, the empirical study includes only collaborations that utilize an intermediary organization – an organization that assists this collaboration (Chapter 2.3). However, in order to get a solid understanding of the context the literature review (Chapter 2) includes success factors of both mediated and unmediated UI-collaboration.

1.2.1 Project Innopolis

The research presented in this thesis is conducted in Aalto University School of Science as a part of project Innopolis (2010-2012). Project Innopolis was an EU-funded research project which aimed to "*identify and disseminate best practice in innovation policy in university-city regions*" (Innopolis, 2015). The project was a partnership of four cities and four universities in four European university-city regions: Greater Manchester (University of Salford), Helsinki (Aalto University), Łódź (University of Łódź), and Thessaloniki (Aristotle University). Three research units from Aalto University were involved in project Innopolis: YTK Land Use Planning and Urban Studies Group, Enterprise Simulation Laboratory SimLab, and Design Factory. A fourth unit from Aalto University, Otaniemi International Innovation Centre, functioned as a coordinator. The author of this thesis was a research assistant in Enterprise Simulation Laboratory SimLab (Aalto University, School of Science, Department of Industrial Engineering and Management) in project Innopolis from June 2010 until the end of the project in December 2012.

Project Innopolis presented three guides as its main outputs: 1) Guide to knowledge exchange for policy makers, 2) guide to best policy practices for policy makers, and 3)

policy simulation guide. The policy simulation guide addressed the transferability of policy practices from one city-region to another.

As a part of project Innopolis, partners from Aalto University published two outputs particularly relevant to this thesis: a guide and the Publication included as a part of this thesis. The guide, titled "Building Bridges between Universities and Enterprises", was published in January 2013. Its purpose was to improve the practical impact of findings of the first phase of study presented in this thesis (Chapter 4). The contents of the guide are based on research by Mirje Halla, Annukka Jyrämä, and the author of this thesis, commented by Pauli Alin, art designed by Liina Hongell and Katariina Kähkönen, and edited by Hanna Aspelin.

The Publication was written by three researchers from SimLab (the author of this thesis, Mirje Halla, and Pauli Alin) and was accepted to European Journal of Innovation Management Apr 3rd 2015. The review process was exceptionally long as a special issue for which the Publication was meant was cancelled. The Publication is titled "Openness in university-industry collaboration: Probing managerial perceptions" and is included as a part of this thesis.

1.3 Research problem and theoretical research questions

The research questions of this thesis motivated by existing literature presented in Chapter 1.1 are:

> *First Research Question: What do key personnel in mediated university-industry collaboration perceive as key success factors of their collaboration?*
>
> *Second Research Question: How do managers of intermediary organizations in university-industry collaboration perceive openness?*

Studying these research questions requires theoretical research questions (RQ) to support them. Theoretical research questions are studied and answered in the literature review in chapter 2.

> *RQ1: In what ways can universities and industries collaborate?*
>
> *RQ2: What are the success factors of university-industry collaboration based on existing literature?*
>
> *RQ3: What is the role of intermediary organizations in university-industry collaboration?*
>
> *RQ4: How can managerial perceptions be used to study success factors of university-industry collaboration?*
>
> *RQ5: How is openness university-industry collaboration seen in existing literature?*

1.4 Structure of the study

This thesis consists of two distinct parts: the thesis body and the Publication. The thesis body consists of four sections: introduction, theoretical background, empirical study, and conclusions.

In the introductory section (Chapter 1) the study and its context are introduced, motivated through existing literature, and divided into research questions.

The second section (Chapter 2) of this thesis presents a literature review on the core concepts studied in this thesis. The literature review constructs the necessary theoretical background required to comprehend the context and to relate the findings in this thesis to existing academic discussion.

The third section (Chapters 3 and 4) presents the first phase of the empirical study of this thesis: a study on managerial perceptions of success factors of mediated university-industry collaboration. It consists of methods, data, and findings of the first phase of the study.

The fourth section (Chapters 5 and 6) presents the discussion and conclusions of the first phase of study, including practical and theoretical implications, credibility, limitations and suggestions for future research. It answers the first research question and builds a bridge to the second phase of study, which is based on the findings of the first phase, summarized in Chapter 6 and presented in the Publication.

Introduction	**Literature review**	**First empirical phase of the study**	**Discussion of the first phase of the study**	**Second phase of the study**
1. Introduction	2. Theoretical Background	3. Methods and Data 4. Findings:	5. Discussion of the first phase of the study 6. Summary of the second phase of the study	Publication

These four sections form the first part of this thesis. The second part presents the second phase of the study in the form in which it was accepted to European Journal of Innovation Management.

THEORETICAL BACKGROUND

2 Theoretical Background: University-industry collaboration as an Innovation-generating Mechanism

This section presents a literature review on success factors of university-industry collaboration. It looks into different channels of UI-collaboration (chapter 2.1), success factors of UI-collaboration (chapter 2.2), Intermediary organizations (chapter 2.3), and into how managerial perceptions can be used to study success factors of university-industry collaboration (chapter 2.4). This chapter utilizes long quotes to present how the study in this thesis was motivated in the Publication. The Publication presents existing literature that motivates this study in the following way:

"T*he generation of innovations is a vital driver of economic growth of nations (Hine et al., 2010; Kodama, 2008). Generating innovations is not enough, however: economic growth of nations also requires the diffusion of generated innovations as well as the formation of mechanisms that generate innovations on a regular basis (Hine et al., 2010). Still, developing such mechanisms is challenging (Kodama et al., 2008).*

Knowledge is a fundamental resource and a major element for innovation and the competitiveness of firms, regions and nations (Dossou-Yovo and Tremblay, 2012). The two-way collaboration between universities and businesses is an important source of new knowledge that can lead to commercial innovation (Bishop et al., 2011; Debackere and Veugelers, 2005; Meyer-Krahmer and Schmoch, 1998; Yusuf, 2008). According to Agrawal (2001: 285) it is 'commonly accepted that universities are an important source of new knowledge.'

In addition to being an important source of new knowledge, universities can also help in diffusing innovations. Mansfield (1998) found that without academic research over 10% of new product introductions in his data would not have been developed on time. Bishop et al. (2011) also point out that university research contributes to industrial innovation. Thus, it appears that university-industry collaboration can be an important mechanism that can generate innovations on a regular basis. We define university-industry collaboration as collaboration between universities and firms with the intention of generating and/or diffusing innovations."

2.1 Channels of University-industry collaboration

There are many channels through which universities and industries can collaborate. The choice of channels is affected by many factors and the factors of one firm can be different from the factors of another (Agrawal and Henderson, 2002). Different industries also tend to value these channels differently (Agrawal, 2001). Even if there are many channels to choose from, some are more popular than others. Schartinger et al. (2002) found that the most common ways for firms to collaborate with universities include contract research

and consulting, collaborative research, financing of university research by firms, joint supervision of Ph.D or master's theses and joint scientific publications.

Channels universities and industries use to collaborate have been categorized in many ways in existing literature. De Fuentes and Dutrénit (2012) found four: the degree of formality, the degree of interaction, the direction of knowledge flows and the potential of obtaining applied results. Channels can also be categorized based on type of knowledge involved, some project-level characteristics and by whether their impacts are short-term or long (De Fuentes and Dutrénit, 2012).

There have been quite a few lists of channels universities and industries use to collaborate. In his review Agrawal (2001) gave a rather exhaustive list of used channels of UI-collaboration mentioning "publications, patents, consulting, informal meetings, recruiting, licensing, joint ventures, research contracts and personal exchange". Table 1 uses Agrawal's list as a base and provides the lists of Schartinger et al. (2002) and Bruneel et al. (2010) for comparison.

Agrawal (2001)	**Schartinger et al. (2002)**	**Bruneel et al. (2010)**
Publications	Joint publications, Joint supervision of Ph.D and Masters theses, firm's reading publications	N/A
Patents	Patents	N/A
Consulting	Consulting	Consulting
Informal meetings	Informal meetings, talks and communications	N/A
Recruiting	Employment of graduates by firms, mobility of researchers between universities and firms, sabbatical periods of university members	Recruitment of recent graduates and post-graduates
Licensing	Licensing of university patents by firms, purchase of prototypes developed at universities	N/A
Joint ventures	New firm formation by university members	N/A

Research Contracts	Collaborative research, joint research programmes, contract research	Joint research projets, contract research
Personal Exchange	N/A	Student placements
N/A	Conferences and other events	N/A
N/A	Training of firm members, Lectures at universities by firm members	Training of firm employees, post-graduate training in a company
N/A	Use of university facilities by firms	N/A

Table 1: Channels of University-Industry Collaboration presented in existing literature

2.1.1 Choice of channels

Patents and licenses are a rather traditional channel of transferring knowledge between universities and industry. However, Agrawal (2001) points out that more recent studies have seen the role of patents and licenses as rather small, which can be a response to earlier heavy focus on patents as a channel. Formal channels such as patents are more easily observed and measured, which might have led to the emphasis that has been given to them in earlier studies (Gertner et al., 2011). But since it is suggested that firms look to "capacity building and learning rather than tangible outcomes" in their collaboration with universities (Perkmann and Walsh, 2007: 272), Gertner (2011) joins Agrawal (2001) in suggesting patents are a rather minor form of collaboration (Gertner et al., 2011). Licensing fees and patents remain, however, as a source of income for universities (Yusuf, 2008).

The choice of channels includes multiple factors to optimize. For example, the characteristics of knowledge, e.g. the amount of codification (Schartinger et al., 2002) and potential economic value of knowledge affects the choice, as changes in secrecy, increased trust or exclusiveness of usage of results might become a topic. (Saviotti, 1998).

De Fuentes and Dutrénit (2012) vouch for channels related to joint and contract R&D, property rights and human resources and claim for them to have high impact on long-term benefits for firms. Schartinger et al. (2002) deem direct research collaboration as particularly effective. Contract research can also be found in Arza's (2010) preferences which include bi-directional learning channels, such as joint and contract research and commercial channels, e.g. consultancy. He claims these channels are particularly useful in conveying novelty, which might derive from their larger involvement of articulation than other channels, which is useful for transmission of tacit knowledge (Perkmann and Walsh 2009).

Spin-off firms built on university knowledge provide one channel for UI-collaboration. Universities have been pushing their intellectual property through this channel by

encouraging students and faculty to be entrepreneurial, establishing incubators, creating science parks or funding start-ups (Yusuf, 2008).

Conferences as a channel between universities and industries is not very effective, as academic conferences are often not attended by practitioners and vice versa (Hughes et al. 2008). Nevertheless, people carry knowledge with them when they move from one environment to another. Workforce mobility has been perceived as particularly important for UI-collaboration by Chesbrough (2012), the creator of open innovation paradigm, and Yusuf (2008) has presented that students and graduates carry knowledge with them back and forth.

For building relationships to university personnel Agrawal (2001) recommends collaborative research projects, hiring professors as consultants, sponsoring university lab projects, and participating in research consortia.

2.1.2 Multiple channels

A collaboration is not limited to one channel, as many channels can work in unison. Bruneel et al. (2010: 863) used the amount of channels used for collaboration to define a concept they called "breadth of interaction". The channels they used to define breadth of interaction included joint research projects, contract research, consultancy, training of firm employees, post-graduate training in the company, recruitment of recent graduates or postgraduates, and student placements (Table 1).

Willingness to invest in many channels enables building of routines for long-term and mutually beneficial exchanges (Bruneel et al., 2010). It e.g. assists in handling conflicts of interest in research priorities (Bruneel et al., 2010) and the breadth of interaction of individual academics also ease university-industry collaboration (D'Este and Patel, 2007). However, while breadth of interaction diminishes orientation-related barriers, it has been found to increase transaction-related barriers (Bruneel et al., 2010). This is because interaction across many different channels can lead to "messy and labour-intensive" interactions as approaches to conflicts may vary in different parts of universities (Bruneel et al., 2010). Whatever the choice of channels, the interactions should be of repetitive nature and include frequent communication (Bruneel et al., 2010; Niedergassel and Leker, 2011).

2.1.3 Type of knowledge as related to choice of channels

The type of transferred knowledge also affects which channel should be chosen for UI-collaboration (Schartinger et al., 2002). Tacit knowledge, which forms the basis of firm-specific advantage involves demonstration and learning by doing (Gera, 2012). If the collaboration wishes to enable sharing of tacit knowledge the chosen channel should support social interaction such as observation, discussion, experience sharing or imitation (Gera, 2012). Formal occasions, such as conferences and seminars, are not as effective in sharing tacit knowledge. However, they are often the only interaction between researchers and practitioners, and due to their emphasis on explicit knowledge exchange diffusion of tacit knowledge can be rather limited (Gera, 2012).

Explicit knowledge can be transferred through formalized transfer mechanisms, such as publications, operating manuals, software, patents, informal discussions, collaborative research and the movement of people (Schartinger et al., 2002). Gera (2012) points out that explicit knowledge is diffused in the forms of publications, books, reports, manuals, conferences, seminars and online databases.

This chapter has provided an answer to theoretical research question RQ1: In what ways can universities and industries collaborate, by listing and inspecting different channels of university-industry collaboration found in existing literature.

2.2 Success Factors of University-industry collaboration

Success factors of university-industry collaboration are rather widely studied in existing literature. The purpose of this chapter is to present an idea what kind of factors existing literature presents as affecting the success of university-industry collaboration in at least some channel. I categorize these success factors into two categories: (1) pre-collaboration characteristics and (2) collaboration-specific characteristics. Pre-collaboration characteristics refer to characteristics of any collaborator that exist before a specific collaboration, thus making it slower to affect them and more difficult to prepare for a specific collaboration. Collaboration-specific characteristics refer to characteristics that can be more easily affected by decisions regarding a specific collaboration or its practices.

2.2.1 Pre-collaboration characteristics

Absorptive Capacity

Absorptive capacity enhances the exchange of knowledge between universities and enterprises (Dyer and Singh, 1998; Hadjimanolis, 2006; Lee, 2000; Bercovitz, 2007; Kodama, 2008; Yusuf, 2008). Absorptive capacity refers to a firm's ability to recognize the value of new information, assimilate and apply it (Cohen & Levinthal, 1990). It has been found to be especially important in the transfer of tacit knowledge (Kodama, 2008).

Lane and Lubatkin (1994) and Dyer and Singh (1998) build on Cohen and Levinthals concept and argue that absorptive capacity can be of relative nature so that a certain organization's absorptive capacity varies depending on which organization it collaborates with. Lane and Lubatkin (1994) use the term relative absorptive capacity, where Dyer and Singh (1998) prefer to call it partner-specific absorptive capacity.

Existing literature statest that absorptive capacity is greatly affected by similarity of the knowledge base between the collaborators (Cohen and Levinthal, 1990; Dyer and Singh, 1998). This knowledge base includes basic skills and shared language, but can also include knowledge of the latest scientific and technological findings on a certain subject.

A firm can enhance their absorptive capacity and make themselves better at exploiting external knowledge e.g. by doing their own research and development, and especially focusing on explorative projects (Bercovitz, 2007; Chesbrough, 2012; Spithoven et al., 2011). Even if in-house R&D has been seen as a very important method, absorptive

capacity can also be generated as a by-product of daily work, training of employees (Cohen & levinthal 1990; Agrawal, 2001) or interacting with universities (Bishop et al., 2011).

Absorptive capacity is affected by numerous factors (Meyer-Krahmer and Schmoch, 1998; Agrawal, 2001). Agrawal emphasized recruiting graduate students, hiring professors as consultants, modifying internal incentives to publish or patent, funding university research, participating in research consortia, sending company scientists to university labs as visiting scientists, and engaging in collaborative research with university scientists. Meyer-Krahmer and Scmoch (1998) emphasized the structural characteristics of absorptive capacity, stating that absorptive capacity depends on "meso-level" factors: science intensity of technologies, industrial life cycle, and firm structure, and the micro-level factors of internal R&D capacity of firms, interaction patterns to relevant technologies outside traditional linkages, formal co-operation, and informal networks.

The absorptive capacity of an organization depends on the absorptive capacities of their members (Cohen and Levinthal, 1990). Especially "gatekeepers" located at the interface of the organizations are in a critical role (Cohen and Levinthal, 1990; Spithoven et al., 2011).

Collaborative partners can enhance their relative absorptive capacity by planning inter-organizational practices to facilitate knowledge exchange and enhance inter-organizational social networks (Dyer and Singh, 1998). Especially knowledge exchange practices that maximize the frequency and intensity of interaction are particularly useful. Relative absorptive capacity also strengthens with time as collaborators learn to recognize where to find critical information or expertise in both organizations (Dyer and Singh, 1998). Organizational structures and similarity of ways of thinking also enhance relative absorptive capacity (Lane and Lubatkin, 1994).

Culture and Attitude

Lack of alignment in culture can be a hindrance to university-industry collaboration (Gera, 2012; Suvinen et al., 2010). This alignment in organizational culture affects university-industry collaboration mainly through mechanics of trust and sharing (Gera, 2012).

The issue of alignment of culture can be approached from either the side of firms or universities. For a firm to utilize knowledge from higher education institutions it needs to create appropriate culture, which includes human environment, practices and incentives (Gera, 2012). In a similar way, a business-oriented culture inside a university has been seen to enhance collaboration (Suvinen et al., 2010). However, universities can be reluctant to foster a business-oriented culture. Attitudes of university faculty may be affected by fear that close collaboration with firms can interfere with the core values of a university: education, research and integrity (Lee, 1996).

Bruneel et al. (2010) saw that partners can "converge in attitudes" (pp. 860) through experience in collaboration. This way they can learn to share common norms and reach shared understanding of the collaboration and its process. Especially challenges in attitude related to long-term nature of basic research are lowered through experience, whereas university administrative procedures or conflicts over immaterial property are not (Bruneel et al, 2010).

Lee (1996) notes that cultural differences between universities and industry should not be only treated as barriers, but they should be respected instead. Building a culture that encourages and rewards people from these two rather different cultures to socialize and build networks is important (Gera, 2012), which is further explored in the following chapter.

Networking

Contacts and networking are vital to collaboration between universities and industries (Debackere and Veugelers, 2005; Gertner, 2012; Yusuf, 2008). It has been argued that given their usefulness, incentives should be given for academics to build networks by socializing with practitioners (Gera, 2012), as overlapping personal and professional relationships establish more successful university-industry collaboration (Bruneel et al., 2010; Wright et al., 2010). Networks assist formal collaboration, but the relationships themselves can also be important sources of knowledge between academics and practitioners, as personal contacts can be directly consulted for problem solving (Bishop et al., 2011).

One approach to networks in existing literature has been the strength of interpersonal connections, called tie strength (Hansen, 1999; Niedergassel and Leker, 2011). Tie strength is considered to be influenced by frequency of communication and the closeness of individuals (Hansen, 1999; Niedergassel and Leker, 2011). Strong ties have been seen to especially help sharing tacit knowledge (Hansen, 1999; Niedergassel and Leker, 2011). Networks have been found to be of particular importance in the case of university spin-offs, as strong ties with established firms have been seen to affect their success (Suvinen et al., 2010), which is in line with Debackere and Veugelers (2008) who underlined the benefits of having had R&D collaborative agreements with industry. The literature on effect of weak ties on UI-collaboration remains controversial (Niedergassel and Leker, 2011).

Critical mass

The scale of resources of an academic entity – both research personnel and research income – is seen attract attention from industry and drives the academic entity to university-industry collaboration (D'Este and Patel, 2007). However, Suvinen et al (2010) found that the size of the university does not seem to positively affect collaborative network relationships or commercial success. The size of a university seems to be particularly useful for university spin-offs, as being able to leverage a critical mass of research equipment, university infrastructure and knowledge diversity in a university

promotes their success (Debackere and Veugelers, 2005). In industries critical mass has been mostly seen to regard the critical mass of qualified staff required for absorptive capacity (Spithoven et al., 2011).

Experience of collaboration

Experience of collaboration, either with a specific partner or similar partners, has been determined to affect the success of university-industry collaboration (Bruneel et al., 2010; Hoang and Rothaermel, 2005). E. g. experience of collaborative research lowers orientation-related barriers of future collaborative research (Bruneel et al., 2010). Likewise, lack of experience has been seen as a barrier of collaboration, such as in the case of a firm's lack of experience in reading scientific literature (Hadjimanolis, 2006).

Experience helps collaborators form routines and practices which can be refined and reused in recurring collaborations, and learnings from past difficulties can be used to plan future collaboration (Bruneel et al., 2010). In the case of joint research experience also lowers cultural barriers related to basic and long-term nature of university research and helps to reach shared attitude and understanding on research methods and targets (Bruneel et al., 2010). However, experience does not seem to lower barriers related to university administrative procedures and conflicts over IP, even though experience does bring standards for negotiations of IP ownership (Bruneel et al., 2010). Experienced firms might also be more familiar with differences in IP practices of different universities, giving them an edge over more inexperienced firms (Bruneel et al., 2010).

In addition to experience of generic collaboration, existing literature has found that collaborators that have experience of collaborating with each other are also more likely to be successful by being able to solve conflicting views on research targets, dissemination of results and timing of deliverables (Bruneel et al., 2010).

Experience of university-industry collaboration has been seen to leave a print on academics, leading to expectations for continuing collaborative practices (Bercovitz and Feldman 2003). The academic's experience in collaborative research has also been seen to make him more probable to engage in a greater variety of interactions and more frequently across a wider set of interaction channels (D'Este and Patel, 2007).

Experience can be leveraged to create routines and practices of university-industry collaboration and the management of this collaboration. Creating routines and practices has been seen as beneficial as it eases reaching shared understanding of goals and process (Bruneel et al., 2010), promotes trust and reduces uncertainty (Schartinger et al., 2002).

Expertise

The reputation and status of an academic can be used for commercial ends, increasing variety of interactions between university and industry (D'Este and Patel, 2007). Training personnel can be a powerful tool to enable university-industry collaboration for both firm personnel (Goh, 2002) and academics (Debackere and Veugelers, 2005). Some amount

of qualified industry staff is needed to absorb university knowledge (Gann, 2001), an idea related to absorptive capacity (Cohen and Levinthal, 1990).

Different expertise has been emphasized in different channels of university-industry collaboration. In the case of university spin-off, there can often be a lack of skills regarding laws of business (Suvinen et al., 2010), whereas in the cases of contract research the collaboration should include know-how and processes for legal, financial and human resources management issues (Debackere and Veugelers, 2005).

2.2.2 Collaboration-specific characteristics

Shared Understanding and Common Language

Reaching shared understanding is important for the success of university-industry collaboration (Gertner et al., 2011; Hughes et al., 2008). It can be understood as either shared understanding of the goals of a collaboration, shared understanding of the process, or both.

Universities and firms may have rather different views of goals of a collaboration. If research is motivated and published based on universities' incentives, it is possible it won't have much relevance to industry (Gera, 2012), as the universities may lack knowledge about the "laws of business" (Suvinen et al., 2010: 1377). These incentives can be, for example, the recognition and reputation in the scientific community, being able to access the partner's knowledge base (Niedergassel and Leker, 2011), and reaching results that are accessible to the public (Hall et al., 2001). These goals may bring conflicts with a firm that wants exclusive rights to the intellectual property (Hall et al., 2001). The preferred form of the results may also be an issue, as universities may provide complex and abstract results where the firms would have preferred concrete and practical (Niedergassel and Leker, 2011) and the distribution of benefits from these results may be controversial (Bruneel et al., 2010).

Research problems are often framed in the context of the research, which can often be a lot wider that context where the solutions are needed by the industry partners (Gera, 2012), which can be one of the reasons leading to research results being irrelevant to practice (Gera, 2012; Suvinen et al., 2010). The fear of irrelevant knowledge puts emphasis on the importance of demonstrating the relevance of scientific knowledge involved in a collaboration, e. g. in the case of motivating practitioners to join conferences or knowledge networks (Hughes et al, 2008).

In addition to sharing an understanding of the goals of the collaboration, having shared understanding of the process is also important. The timing and form of results can provide difficulties, as a research cycle can be slow and research might have a time gap too long for industry partners to utilize the results (Bruneel et al., 2010; Gera, 2012). However, focusing solely on short term research is also not a viable option, as directing research agendas to medium to long term problems in industry have also been seen to bring research that is valuable to industry (Gera, 2012).

A firm's lack of knowledge about the research process can also lead to problematic requirements for the collaboration (Gera, 2012). Agreeing on a process for collaboration is a well-proven way to enhance shared understanding in a collaboration (Braun and Hadwiger, 2011). Shared understanding of the process is enhanced by experience of collaboration with the same partner (Bruneel et al., 2010; Gertner et al., 2011).

Universities and industry have different mindsets, which makes it difficult for them to have shared meanings of the context, which is required for sharing tacit knowledge (Gera, 2012). Investing in interaction based on mutual understanding of incentives and goals creates trust and enhances collaboration (Bruneel et al., 2010).

When discussing shared understanding, numerous papers have brought up the need for common language. Common language has been seen as a success factor of university-industry collaboration both literally (e.g. Braun and Hadwiger, 2011; Hughes et al., 2008) and metaphorically (e.g. Klerkx and Leeuwis, 2008). As scientific articles, workshops and meetings are often held in English, firms lacking in English skills can find it hard to grasp this information without translation to local language (Braun and Hadwiger, 2011). Hughes et al. (2008) point out that academic language in itself can be a barrier for collaboration, as academic language and structure of academic papers are not understandable to practitioners.

Common language can also be seen as the ability understand and communicate with people from different backgrounds. For example, Klerkx and Leeuwis (2008: 370) state that "[an intermediary organization] speaks the language of agricultural entrepreneurs, policy makers and researchers." Face-to-face interactions are especially useful in forming a common language (Schartinger et al., 2002).

As for reaching shared understanding, Braun and Hadwiger (2011) suggest that information should be processed so that the receiving entity can understand it, without losing the critical information. In some areas this can be extremely difficult, and they saw "extensive workshops and intensive assistance" and intermediaries as the best ways to handle the situation (Braun and Hadwiger, 2011: 92).

Close Collaboration

Opportunities for interpersonal contact and social processes, such as face-to-face meetings, enhance inter-organizational collaboration (Dyer and Singh, 1998; Gertner et al., 2011) as they help overcome many barriers of knowledge-based collaboration (Agrawal, 2001; Gera, 2012). Human interaction is one of the best forms of knowledge transfer, and even the improvement of communication technologies has not completely substituted face-to-face contacts (Schartinger et al., 2002).

Close interaction can be arranged either formally or informally, and even informal contacts are important (Meyer-Krahmer and Schmoch, 1998). Chesbrough (2012) sees collaborating side by side important enough to state that to move knowledge you actually need to move people.

Tacit knowledge is regarded as particularly important for an effective knowledge exchange in innovation processes (Schartinger et al., 2002). The importance of close collaboration and personal interaction is greatly derived from its importance to – or even being a precondition to - sharing of tacit knowledge (Bruneel et al., 2010; Gertner et al., 2011; Schartinger et al., 2002; Yusuf, 2008), as it significantly enhances the success rate of collaboration involving this kind of knowledge (Niedergassel and Leker, 2011). A possible mechanism for this is reaching reciprocal incentives for cooperation through close collaboration (Niedergassel and Leker, 2011).

Direct interaction might not be required in the most formal channels, which require less exchange of tacit knowledge (Agrawal, 2001). On channels of collaboration that are based on more informal linkages social links and relationships are vital for successful knowledge exchange (Perkmann and Walsh, 2007).

Close collaboration assists university-industry collaboration in many ways. Through close collaboration universities and enterprises can "learn to share common norms", reduce orientation-related barriers (Bruneel et al., 2010: 860) and enhance the collaboration (Gertner et al., 2011). Direct personal interactions have been seen to contribute to trust, common language and culture (Schartinger et al., 2002). Personal contacts have also been seen to build absorptive capacity (Schartinger et al., 2002). Face-to-face meetings are needed for functioning networks (Bruneel et al., 2010; Yusuf, 2008), but networks also assist close collaboration as personal referrals are a good initiator for direct interaction (Bruneel et al., 2010).

Being close geographically is also an issue worth noting. The geographical distance between a university and the collaborator has been seen to be a factor for the success of collaboration with shorter distance translating to better success (Agrawal, 2001; Niedergassel and Leker, 2011). However Agrawal (2001) found that proximity was explained by frequent scientific interaction. When the amount of interaction was increased, proximity became an insignificant factor. Schartinger (2002) found that geographical distance affected the collaboration only in the case of contract research, where probability to find potential partners for collaboration was lower. Bishop et al (2011: 38) found that proximity only brought benefits related with "direct assistance in problem solving".

IP-policies

IP-Policies are a central issue in knowledge collaboration as knowledge has considerable value and it can be given away relatively easily (Braun and Hadwiger, 2011). Von Hippel insists that intellectual property protection is unnecessary and unhelpful to innovation (Chesbrough, 2012). Chesborough (2012: 22) disagrees. He claims that IP "actually enables companies to collaborate and coordinate, confident in the knowledge that they will be able to enjoy some protection from direct imitation by others in the community". Following this line of thought, IP policies, which are sometimes seen as an opposite of openness, might actually promote openness. Braun and Hadwiger (2011) agree, stating

that if knowledge is to be given away, it is important to reward the entity sharing knowledge, so that both sides profit from the knowledge exchange.

Formal, more closed IP-policies and non-disclosure agreements are often used in industries, whereas projects in academia often do not (Gertner et al., 2011; Niedergassel and Leker, 2011). However, this controversy has shown signs of dissolving as both sides are working towards a mixed culture regarding IP-policies and university administrators have also started looking into possibilities IP protection and exploitation give (Gertner et al., 2011). Gertner et al. (2011: 627) state that this can also raise barriers as "over-optimistic valuations may be placed on university intellectual property".

IP-policies that prevent publishing the research hit academics particularly hard as publishing results of a research is often a factor in university evaluation (Geuna and Martin, 2003).

Trust

"Inter-organizational trust is one of the strongest mechanisms for lowering the barriers to interaction between universities and industry" (Bruneel et al., 2010: 867). It facilitates university-industry links (Braun and Hadwiger, 2011) by enhancing knowledge transfer performance (Chen, 2004). However, even if it is a strong success factor, it does not guarantee the success of a collaboration (Niedergassel and Leker, 2011).

As trust is seen as a rather vital success factor of university-industry collaboration, it is comforting that overall level of trust often seems to be higher in university-industry collaboration than industry collaboration (Niedergassel and Leker, 2011).

Uzzi (1997: 43) expresses trust as "the belief that an exchange partner would not act in self-interest at another's expense". It makes collaborators confident that they will be treated fairly, in a consistent way, and that possible problems can be resolved jointly (Bruneel et al., 2010).

The relationship between trust and the type of knowledge exchanged has been controversial in the extant literature. Trust has been seen as important for exchange of tacit knowledge (Bruneel et al., 2010). However, Niedergassel and Leker (2011) found that trust is of special importance mainly in the context of explicit knowledge, not tacit knowledge.

The reasons why trust is important for university-industry collaboration have been speculated to be based on the involvement of sharing sensitive information and tacit knowledge (Bruneel et al., 2010). Collaboration related to knowledge exchange often includes high levels of uncertainty and can include sensitive knowledge about a firm and its strategy, which trust helps to mitigate (Gertner et al., 2011; Schartinger et al., 2002). Low level of trust may lead to partners withholding knowledge that could be vital in making the collaboration successful (Inkpen and Tsang, 2005).

Trust reduces barriers of UI-collaboration as it reduces fears that a partner acts opportunistically, and leads to better management of expectations (Bruneel et al., 2010). As a result, less contractual safeguards against opportunistic behavior are used (Gulati, 1995).

Building trust between universities and industry is challenging. It can be particularly effectively built through direct personal interactions, such as face-to-face communication (Schartinger et al., 2002). Bruneel et al (2010: 867) state that "[Trust] requires long-term investment in interactions, based on mutual understanding about different incentive systems and goals". Gertner et al. (2011: 627) are on the same lines stating that trust requires "Close relationships, fostered by staff mobility between academic and industrial contexts (Perkmann and Walsh, 2007)".

The connection between IP-policies and trust doesn't seem to be widely studied in the existing literature. Bruneel et al. (2010) state that IP-policies have been viewed to build good-will because creating acceptable rules for patent rights contribute to securing the good-will of partners. They also interpret existing literature to make good-will a factor in trust, as trust demonstrates a willingness to understand and adjust behaviors to align with the needs and expectations of the partner (Bruneel et al., 2010).

Type of knowledge

People know more than they can explain. Knowledge can be categorized into two parts: tacit and explicit knowledge (Nonaka, 1994). Exchange of explicit knowledge in UI-collaboration can be relatively straightforward, as "explicit knowledge refers to knowledge that can be articulated and transmitted in a formal, systematic language. It can be easily processed, transmitted and stored using (electronic) media" (Niedergassel and Leker, 2011: 143). Tacit knowledge, on the other hand, is difficult to formalize and communicate as it is "deeply rooted in action, commitment and involvement in a specific context" (Nonaka, 1994: 16). Tacit knowledge is difficult to transmit over distance and its context-specific nature makes it spatially sticky (Gertler, 2003).

UI collaboration profits from including both tacit and explicit knowledge (Yusuf, 2008; Wright et al., 2008). Tacit knowledge is unexpressed and provides unique competencies that cannot be easily replicated by competitors, which makes it particularly important (Barney, 1991). Explicit knowledge is more easily articulated, leading to IP policies to protect the value of this knowledge (Wright et al., 2008).

Knowledge spillovers have a tacit component that tends to remain geographically local due to the effect of direct interaction and relationships in exchanging tacit knowledge (Agrawal, 2001; Dyer and Singh, 1998). Many pioneering firms draw on tacit knowledge of university researchers as the knowledge has not yet been codified, which makes proximity, contacts, joint papers and using multiple knowledge exchange channels important (Yusuf, 2008).

Frequency of communication seems to affect both types of knowledge, while close collaboration is particularly important for tacit one (Niedergassel and Leker, 2011). The value of active and "many faceted" intermediation is also higher in the cases of tacit knowledge (Yusuf, 2008). Setting the right context of virtual, physical or mental space assists transfer of tacit knowledge (Nonaka et al., 2000). Turning tacit knowledge into explicit knowledge by codifying it facilitates knowledge sharing, even though it makes it easier to replicate (Chen, 2004).

Open Innovation and Openness

This subchapter presents the concepts of Open Innovation and Openness. Even if Open Innovation is a strategy of a very firm-centric approach, it is an approach that cherishes UI-collaboration, and is close to openness. Thus, Open Innovation and Openness are included in the same subchapter for comparison.

Even if universities and enterprises have collaborated for a long time, the discussion on open practices in the area of innovation is rather new. The term "open innovation" practically didn't exist before Henry Chesbrough opened the discussion in 2003 in his highly cited book "Open Innovation". Afterwards firms have changed their traditional business strategies to allow more open forms of innovation (Chesbrough and Appleyard, 2007). The term has multiple meanings, which makes it a rather elusive concept to study (Chesbrough, 2012), which increases the importance of study around the concept. Chesbrough (2012: 20) defines open innovation as "*the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation".*

Open innovation has become the new way of innovation during the last decade, as even different views of open innovation *"share the insight that being open is a powerful generative mechanism to stimulate a lot of innovation"(*Chesbrough, 2012: 21). It encourages firms to use external ideas in addition to internal ideas and external paths to market in addition to internal ones. The processes of open innovation combine internal ideas with external ideas into platforms, architectures and systems (Chesbrough, 2012).

Open Innovation includes both directions of openness: being open to external ideas and openly giving away ideas – even if not for free (Chesbrough, 2012). Chesbrough (2012) motivates inside-out openness, stating that ideas should not just be kept inside, they should be let out to be used by others, while ensuring it benefits the original owner of the idea.Chesbrough (2012) argues that having IP practices promote open innovation by enabling enterprises to collaborate and coordinate without the fear of direct imitation by others in the community.

An example of open innovation would be the handling of "false negative" projects – knowledge spillovers that don't fit the current business model. In closed innovation, these spillovers are regarded as costs – in open innovation either the business model is expanded to include these spillovers or they are spun off outside the firm (Chesbrough, 2012).

Open innovation paradigm includes all kinds of organizational collaboration and uses a firm-centric approach to firm's options of innovation. One of these options is university-industry collaboration. In open innovation paradigm, the firm uses external ideas to fuel their own innovation processes. An open innovation process thus might include collaboration with a university, which feeds external ideas to the process on a regular basis.

The mechanics of open innovation depend on the type of innovation at play and merely importing knowledge is not always enough for increased innovation performance. E.g. Greco et al. (2015) argue that "*mere importation of knowledge from the outside alone can do little [to] enhance process innovation, which often requires continuous reengineering and continuous improvement*". They state that active collaboration is needed for comprehension vital to process innovation.

Openness, as defined by Fontana et al. (2006) takes a wider approach to openness. Openness is a key concept studied in the Publication, and it was reviewed the following way:

"The effective operation of intermediary organizations in university-industry collaboration requires a certain level of openness from the firms and the university partners. Laursen and Salter (2004) discussed the concept of openness as the number of external channels firms can use to innovate. Fontana et al. (2006: 311) built on this discussion and argued that researchers should examine the concept of openness more widely, as 'the set of activities carried out by firms to both gather information from and voluntarily reveal knowledge to the external world.'

Fontana et al. (2006) found that firms' openness to the external environment has an important effect on their collaboration with public research organizations. These authors further defined openness as 'the broad set of activities that firms can conduct to acquire knowledge from, voluntarily disclose knowledge to and/or exchange knowledge with the external world' (Fontana et al. 2006: 310). They also claimed that openness is 'very important in explaining their [firms] patterns of collaboration with PROs [public research organizations]' (Fontana et al, 2006: 321). "

This chapter, including this quotation from the Publication, presented an answer to theoretical research question RQ5: How is openness university-industry collaboration seen in existing literature.

2.2.3 Summary

Many success factors have similar elements, and some of them are affected by others. It is likely some factors affect the success of UI-collaboration by being mediated by other success factors. However, as the purpose of this chapter is to explore which factors existing research presents as important, these factors are presented separately.

The literature review in this chapter answers theoretical research question RQ2: what are the success factors of university-industry collaboration based on extant literature. The success factors of UI-collaboration based on existing literature can be divided into two lists: Pre-collaboration characteristics (Table 2) and Collaboration-specific characteristics (Table 3). Pre-collaboration characteristics refer to characteristics of any collaborator that exist before a specific collaboration, thus making it slower to affect them and more difficult to prepare for a specific collaboration. Collaboration-specific characteristics refer to characteristics that can be more easily affected by decisions regarding a specific collaboration or its practices.

Success Factor	Details	References
Absorptive Capacity	A firm's (relative) ability to recognize the value of novel information and assimilate it. It is affected by e.g. similarity of knowledge base and practices and having firm's own R&D.	Bercovitz, 2007 Cohen and Levinthal, 1990 Dyer and Singh, 1998 Hadjimanolis, 2006 Lane and Lubatkin, 1994 Lee, 2000 Meyer-Krahmer and Smoch, 1998 Kodama, 2008 Yusuf, 2008
Culture and Attitude	Alignment in culture enhances UI-collaboration. Culture includes e.g. human environment, practices and incentives.	Bruneel et al, 2010 Gera, 2012 Lee,1996 Suvinen et al, 2010
Networking	Building networks by overlapping informal relationships with formal ones affects the success of UI-Collaboration. Strong ties are important for exchange of tacit knowledge.	Bruneel et al., 2010 Debackere and Veugelers, 2005 Gera, 2012 Gertner, 2012 Hansen, 1999 Niedergassel and Leker, 2011 Perkmann and Walsh, 2007 Wright et al., 2008
Critical mass	Critical mass of knowledge diversity, qualified staff, research equipment and resources as a success factor has been argued for and against.	Gann, 2001 Suvinen et al., 2010 Wright et al., 2008
Experience of collaboration	Experience in collaborating with a	Bercovitz and Feldman, 2003

Success Factor	Details	References
	specific partner and experience in UI-collaboration in general lower barriers of orientation, culture and attitude. Building routines and practices plays a notable part. Creates shared understanding and trust and reduces uncertainty.	Bruneel et al., 2010 D'Este and Patel, 2007 Hadjimanolis, 2006 Hall et al., 2003 Hoang and Rothaermel, 2005 Schartinger et al., 2002
Expertise	Expertise is a factor in absorptive capacity. Additionally skills in e.g. laws of business or legal or financial issues may be needed. Lack of expertise can be supported by mentors and training.	Gann, 2001 Goh, 2002 Suvinen et al., 2010

Table 2: Pre-collaboration success factors

Success Factor	Details	References
Shared understanding	Can mean shared understanding of goals of the collaboration or shared understanding of the process. Universities and firms may have different goals, contexts and incentives. Common language is important, both literally and metaphorically.	Braun and Hadwiger, 2011 Gera, 2012 Gertner et al, 2011 Hughes et al, 2008 Klerkx and Leeuwis, 2008 Niedergassel and Leker, 2011 Schartinger et al., 2002
Close Collaboration	Stands for personal contacts and social processes, e.g. face-to-face meetings. It affects trust, finding common language and culture, and builds absorptive capacity. Important for sharing tacit knowledge, not that important in sharing explicit knowledge. Geographical proximity tends to be a success factor through increased interaction.	Agrawal, 2001 Bruneel et al., 2010 Chesbrough, 2012 Dyer and Singh, 1998 Gera, 2012 Gertner et al, 2011 Meyer-Krahmer and Schmoch, 1998 Schartinger et al, 2002
IP-policies	Some see IP-protection as harmful to innovation, some as useful due to protection from imitation	Braun and Hadwiger, 2011 Chesbrough, 2012 Gertner et al., 2011 Geuna and Martin, 2003

Success Factor	Details	References
	when sharing knowledge. IP-policies can also reward for sharing knowledge.	Niedergassel and Leker, 2011
Trust	Trust is a strong success factor of UI-collaboration. It is the belief that a partner would not act in self-interest at another's expense. It demonstrates a willingness to understand and adjust behaviors to align with the needs and expectations of the partner. Knowledge collaboration often includes high levels of uncertainty and possibly sensitive knowledge, which are barriers that are mitigated by trust. Trust is gained through shared understanding, long-term investment and close collaboration.	Braun and Hadwiger, 2011 Bruneel et al., 2010 Chen, 2004 Gertner et al, 2011 Gulati, 1995 Inkpen and Tsang, 2005 Niedergassel and Leker, 2011 Schartinger et al., 2002 Uzzi, 1997
Type of Knowledge	Explicit knowledge is formal and easily transferred. Tacit knowledge is rooted in individual's values, beliefs, experiences and involvement in a specific context, and is difficult to transfer, context specific and spatially sticky. UI-collaboration profits from both.	Agrawal, 2001 Barney, 1991 Dyer and Singh, 1998 Gera, 2012 Gertler, 2003 Niedergassel and Leker, 2011 Nonaka, 1994 Nonaka et al., 2000 Schartinger et al., 2002 Wright et al., 2008 Yusuf, 2008
Openness	Openness stands for acquiring knowledge from, voluntarily disclosing knowledge to and/or exchanging knowledge with the external world'	Laursen and Salter, 2004 Chesbrough, 2012 Chesbrough and Appleyard, 2007 Fontana et al., 2996

Table 3: Collaboration-specific success factors

2.3 Intermediary Organizations

The Publication introduces and motivates the use of intermediary organizations in the following way:

''The need to support innovation through university-industry collaboration has given rise to a novel set of intermediary organizations intended to facilitate this collaboration. Intermediary organizations in university-industry collaboration are organizations that act between organizations coming from these rather different worlds (Wright et al., 2008). Howells (2006: 720) defined an intermediary organization as 'an organization or body that acts [as] an agent or broker in any aspect of the innovation process between two or more parties.' *Howells (2006) also introduced several possible activities that intermediary organizations can take part in, e.g. providing information about potential collaborators, brokering transactions between parties, and helping to find advice, funding and support for the collaboration.*

University-led business incubators or partnership programs are typical examples of intermediary organizations in the context of university-industry collaboration. Moreover, as Howells (2006) and Yusuf (2008) point out, many types of intermediary organizations often work in concert. Intermediary organizations have an important role in facilitating the links between universities and industry (Acworth, 2008; Wright et al., 2008) because they can provide resources that the members of the collaboration cannot or are unwilling to provide (Johnson, 2008). Building on earlier research (Bessant and Rush, 1995; Howells, 2006), Yusuf (2008: 1170) argued that intermediary organizations are useful because they assist in exchanging knowledge between universities and firms by:

> *'bridging ties and interfaces, by diagnosing needs and articulating the demand for certain kinds of innovation, by instituting a dynamic framework for change and working to achieve the change through financing and other means.'*

Likewise, intermediary organizations have been seen to advance innovation in university-industry collaboration (Klerkx and Leeuwis, 2009; Kodama, 2008; Wright et al., 2008; Yusuf, 2008) by bridging and brokering roles between different types of actors. Such intermediation is especially important when the knowledge is tacit (Kodama, 2008; Yusuf, 2008) or when there is a large physical or cultural distance (Kostova and Roth, 2003), which is the case in university-industry collaboration (Lee, 1995).'' (The Publication)

In addition to organizations providing intermediary functions, the concept of intermediation has been recognized on individual level. Chesbrough (2012) states that open innovation effort requires people in a boundary-spanning role to connect knowledge from different sources and combine it, which fits Howells' (2006: 720) definition of "an agent or broker in any aspect of the innovation process between two or more parties". Chesbrough (2012) named these people in a boundary-spanning role "T-shaped managers".

This chapter presented an answer to theoretical research question RQ3: What is the role of intermediary organizations in university-industry collaboration.

2.4 Managerial Perceptions of Success Factors of UI-Collaboration

As presented in the Publication included in this thesis, *"managers are in the business of making decisions concerning how organizations deal with the external environment (Lawrence and Lorsch, 1967). The quality of managers' decisions depends, at least partially, on how managers perceive the organization's environment (Adner and Helfat, 2003). Especially models of rational decision-making suggest that "accurate perceptions increase decision quality" (Weick et al., 2005: 415). A potential theoretical mechanism behind this argument is that because managers respond only to events and phenomena they can perceive (Snow, 1976), the way in which managers perceive key phenomena impacts their decisions."*

On the premise that *"managers perceive primarily only 'those aspects of the situation that relate specifically to the activities and goals' of their departments and organizations (Dearborn and Simon, 1958:140)"* (the Publication), how personnel involved in mediated UI-collaboration perceive the success factors of their collaboration impacts how their organizations respond to events in their environment. As UI-collaboration is seen as vital to innovation (Bercovitz and Feldman, 2007; Yusuf, 2008), this combination of research streams of managerial perceptions and success factors of UI-collaboration bring forth two different needs to understand these perceptions: (1) *what factors* are perceived as the key success factors of UI-collaboration and (2) *how* are these key factors perceived. (1) Motivates the first empirical research question:

> *First Research Question: What do key personnel in mediated university-industry collaboration perceive as key success factors of their collaboration?*

For the purposes of this thesis, only one key success factor is chosen for (2). Openness was chosen as openness is seen as a key success factor of UI-collaboration (Fontana et al., 2006), but it is a rather complicated concept and not well studied. As motivated in the Publication:

"This paper is based on the premise that openness is a key phenomenon in the context of university-industry collaboration (Fontana et al., 2006), and on the premise that managers perceive primarily only "those aspects of the situation that relate specifically to the activities and goals" of their departments and organizations (Dearborn and Simon, 1958:140). Based on these premises, we argue that how managers of intermediary organizations in university-industry collaboration perceive "openness" impacts their decisions concerning how the intermediary organizations respond to events in their environment. However, despite the seeming importance of intermediary organizations' managers' perceptions of their organizations' external environment, there seems to be little empirical research on how intermediary organizations' managers perceive the key concept of openness. We address this limitation by asking how managers of intermediary organizations in the context of university-industry collaboration perceive the concept of openness."

As stated in the Publication, the second empirical research question of this thesis is:

Second Research Question: How do managers of intermediary organizations in university-industry collaboration perceive openness?

This chapter presented an answer to theoretical research question RQ4: How can managerial perceptions be used to study success factors of university-industry collaboration.

FIRST EMPIRICAL PHASE OF THE STUDY

3 Methods and data

This chapter presents the choice of methods, data collection and analysis of the first phase of the study: a study on perceptions of success factors of mediated UI-collaboration. Data collection, analysis and formulating the findings of the first phase were done in collaboration with Mirje Halla, the second author of the Publication.

3.1 Semi-structured interviews as a means of capturing managerial perceptions

Qualitative analysis is used to address the empirical research questions in this thesis. Qualitative analysis makes it possible to analyze how personnel in mediated UI-Collaboration perceive success factors by *"observing how they talk about their organizations during in-depth interviews (Robson, 2002)"* (the Publication). As stated in the publication, "*this strategy is based on the assumption that individuals' perceptions can be observed via in-depth interviews (Crouch and McKenzie, 2006).*"

3.2 Data Collection and Dataset

To collect a data set that enables exploring perceptions of success factors of mediated UI-collaboration, 15 Finnish intermediary organizations involved in UI-collaboration were included in the study. They were involved in UI-collaboration in the following ways: Three were involved in Research collaboration (e.g. partially industry funded applied research labs), eight were involved with University-Industry partnerships (e.g. personal networking support organizations), and four were Start-Up Support organizations (e.g. university-led business incubators.

The first phase of study utilizes 34 interviews of people in mediated UI-collaboration. These interviewees were managers, company representatives, university personnel or other people that took part in a UI-collaboration involving these 15 intermediary organizations. The interviewees answered to questions such as *What does your organization do?; What, in your opinion, are the key factors of success for this kind of knowledge exchange collaboration? and What are the possible key factors of failure for this kind of knowledge exchange collaboration?* (the Publication). An example of the interview questionnaire is presented in Appendix 1. All interviews were semi-structured and lasted for about one hour. All but one were held with individuals face-to-face. "*In the semi-structured interviews we started with a pre-specified set of questions but remained open to ask additional questions based on how the interview proceeded (Myers and Newman 2007).*" (The Publication)

Interviews utilized in this study were conducted by Finnish partners of project Innopolis (Chapter 1.2.1). The author of this thesis was present in 20 of these interviews, which

were done in collaboration with Mirje Halla, the second author of the Publication. These 20 interviews were recorded with digital recorders, transcribed and summarized. The additional 14 interviews were conducted by other Finnish partners involved in project Innopolis. For the first phase of empirical study the author of this thesis received and utilized interview summaries of these 14 interviews conducted by other Finnish partners of Innopolis and 20 interviews in which the author was present, resulting in a data set of 34 interview summaries. This data set is presented in table 4. These 34 interviews consisted of 16 interviews of managers in intermediary organizations (Coded "M" in table 4), 13 interviews of company representatives (C), 3 interviews of researchers (R) and 2 interviews of other key people in the collaboration (O).

Intermediary Organization	Role of the interviewee
UI-Partnerships 1	M1
UI-Partnerships 1	R1
UI-Partnerships 1	R2
UI-Partnerships 1	O1
UI-Partnerships 2	M2
UI-Partnerships 2	C1
UI-Partnerships 3	M3
UI-Partnerships 3	C2
UI-Partnerships 3	C3
UI-Partnerships 4	M4
UI-Partnerships 5	M5
UI-Partnerships 6	M6
UI-Partnerships 6	C4
UI-Partnerships 6	C5
UI-Partnerships 6	C6
UI-Partnerships 6	C7
UI-Partnerships 7	M7
UI-Partnerships 7	C8
UI-Partnerships 7	C9
UI-Partnerships 7	C10
UI-Partnerships 8	M8
Research Collaboration 1	M9
Research Collaboration 1	C11
Research Collaboration 2	M10
Research Collaboration 2	M11
Research Collaboration 3	M12
Start-up support organization 1	M13
Start-up support organization 1	C12
Start-up support organization 1	M14
Start-up support organization 1	O2
Start-up support organization 2	M15
Start-up support organization 2	M16

Start-up support organization 2	C13
Start-up support organization 3	M17

Table 4: Data set of the first phase of empirical study

The data set of interview summaries of 34 interviewees was sufficient for the first phase of study, in which the purpose is to inspect *what factors* are perceived as key success factors of mediated UI-collaboration, and to work as a basis for the second phase. However, interview summaries were decided not to be sufficient for studying *how* managers of intermediary organizations perceive the key success factor of openness, thus the data set was narrowed for the second phase of study. The interviews analyzed for the second phase of study had to fulfill the following criteria: 1) the interviewee is a manager involved in an intermediary organization, 2) the author of this thesis and the second author of the publication were present in the interview and 3) the interviews were digitally recorded and transcribed. For the second phase of study, this resulted in a final dataset of 11 interviews, totaling 13 managers in intermediary organizations. The second phase of study is presented in the Publication.

3.3 First phase of data analysis: Perceived success factors of university-industry collaboration

After 20 recorded interviews were transcribed and summarized they were combined with 14 interview summaries by other Finnish partners of project Innopolis. To analyze perceptions of success factors of mediated UI-collaboration, not only answers to direct questions about success factors of UI-collaboration were included, but also other comments that expressed a perception of a success factor in some way. The interviews were analyzed following the comparative qualitative analysis method (Glaser and Strauss, 1967: 105-115).

The comments in these interviews were coded. First, to gain a good preliminary understanding of the data concerning success factors of mediated UI-collaboration, interviews were coded with data-based codes, e.g. *networks, resources, systemacy, team, commitment, flow of information and communication, shared understanding of goals, know-how, experience,* and *openness*. This follow's Corbin and Strauss's (1990) practice called open coding, and is useful for developing early analytical insights. Smaller codes were then combined to form higher-level categories (Gioia et al., 2013). As a result of coding efforts four categories rose above others as perceived success factors of mediated university-industry collaboration: Networks (33 comments), Openness (47 comments), knowhow and experience (25 comments), and shared understanding of goals and processes (41 comments). These categories form the result to the first research question and are elaborated in chapter 4.

4 Findings: Key personnel's perceptions of success factors of mediated university-industry collaboration

This chapter presents the empirical findings of the first phase of the study. To guarantee transparency of the analysis and credibility of the findings, three comments from the data are presented for each perception. The findings of the second phase are presented in the Publication, which is included in this thesis.

Through the coding efforts of success factors of mediated university-industry collaboration, four categories of perceptions of success factors emerged above others: (1) Networks as a success factor, (2) Knowhow and experience as success factors, (3) Shared understanding of goals and processes as a success factor, and (4) openness as a success factor.

4.1 Perception 1: Networks as a success factor

The interviewed key personnel in mediated university-industry collaboration (table x) perceived that university-industry collaboration was enhanced by proper utilization of networks. The proper utilization of networks included both leveraging existing networks, expanding networks and supporting others in expanding theirs. The justifications of networks as a success factor of mediated university-industry collaboration were perceived to be that they assist in sharing knowledge, and provide resources and potential partners. A manager involved in a start-up support organization (M13) argued that leveraging existing networks is a factor of success for knowledge sharing in the context of their intermediary organization:

> *"Sharing knowledge would be very hard without knowing the key people in universities and in the business world" – M13*

In this comment M13 illustrates how he perceives that knowing the right people i.e. leveraging existing networks, enhances knowledge sharing. As assisting in knowledge sharing is one of the key functions of intermediary organizations (Yusuf, 2008), and since M13 talks about existing networks as vital to knowledge sharing in the context of their mediated university-industry collaboration, this comment illustrates that M113 perceives leveraging existing networks as a success factor of mediated university-industry collaboration.

When asked about the most important barriers for collaboration, another manager involved in a start-up support organization (M16) emphasized the importance of both expanding networks and supporting network building:

> *One has to be active, extroverted and willing to network. --- One also needs to create systems which build communication and collaboration, e.g. programs, exchanges and exercises.--- They [collaborations] don't get born solely from single contacts, of course they help a lot, but there needs to be a system [which builds communication and collaboration] behind it with which to support it even more. – M16*

Since M6 stated that it's vital to be willing to network as a response to a question about barriers of collaboration, this comment illustrates M16's perception that expanding networks (willingness to network) is a success factor of mediated university-industry collaboration. In addition to emphasizing the importance of expanding networks, this comment also shows that M16 perceives that single contacts are a factor of successful collaboration, and this network building can be and should be supported systematically.

A manager of an intermediary organization involved in research collaboration (M11) implied that networks are a success factor of their collaboration by assisting in finding suitable partners:

> *When a good idea for a research project is born in [our organization], they [the researchers] utilize their networks to find suitable organizations to be partners. – M11*

In this comment M11 illustrates how he perceives that networks are a success factor of their collaboration through their importance in finding suitable organizations to partner with.

The comments presented in this subsection imply that key personnel in mediated university-industry collaboration appear to perceive networks as a success factor of their collaboration. These perceptions are in line with existing literature (Debackere and Veugelers, 2005; Gertner, 2012; Yusuf, 2008).

4.2 Perception 2: Knowhow and experience as success factors

The interviewed key personnel in mediated UI-collaboration perceived knowhow and experience as success factors of mediated UI-collaboration. Knowhow and experience of different parties were seen as important, be it personnel of intermediary organizations, enterprises, universities or other partners. When asked about success factors of their collaboration, a manager of an intermediary organization involved in University-Industry partnership (M2) illustrated one way how their own knowhow and experience factors into the success of their collaboration:

> *"It is important that we can find the right people to negotiate with, and to have enough knowledge and understanding to propose the right things." M2*

In this comment M2 illustrates how he perceives that it is important that they have necessary knowhow in their work: being able to find the right people and to have enough knowledge and understanding. Knowhow and experience were required from other collaborators also. A manager of an intermediary organization involved in research collaboration (M9) described this in the following way:

> *"Having the right people with the right competencies is the most important thing, these need to be found and identified. --- The right people can express themselves openly and tell what they think based on their expertise" –M9*

In this comment M9 illustrates how he perceives knowhow and experience [i.e. they tell what they think based on their expertise] of people involved in the collaboration as a success factor. He also perceives openness as a success factor, which will be further elaborated in subchapter 4.4. In this comment he also perceives these two qualities as important enough to be a basis for selection of partners of collaboration.

A CEO of an enterprise involved in start-up support organization (C13) had similar thought about the importance of knowhow and experience of personnel involved in the collaboration. When we asked him for success factors of their collaboration, he answered unambiguously:

> *"The experience and knowhow of the personnel [are success factors of the collaboration]. --- [if] there is lack of respect and trust, these are big barriers. Respect and trust come through expertise and experience." –C13*

This comment by C13 illustrates that the knowhow and experience of personnel isn't important only in the eyes of intermediary organizations' managers, but also in the eyes of companies. This comment also links expertise and experience with trust, which has been seen as a precedent of openness (Lin, 2006).

The comments in this chapter illustrate how key personnel in mediated UI-collaboration perceive knowhow and experience as success factors of mediated UI-collaboration. These perceptions are in line with existing literature (Bruneel et al., 2010; Hoang and Rothaermel, 2005).

4.3 Perception 3: Shared understanding as a success factor

The interviewed key personnel in mediated UI-collaboration perceived shared understanding of goals and processes as a success factor of mediated UI-collaboration. A manager of a university-industry partnership (M2) described the importance of shared understanding of goals:

> *"Building common understanding is important, understanding about why this program exists and what the benefits from it are." – M2*

In this comment M2 explicitly states that shared understanding ("building common understanding") of goals ("why this program exists and what are the benefits from it") is a success factor ("is important"). Since M2 states the importance of shared understanding of goals when talking in the context of the existence of the intermediary organization ("program"), he perceives it as a success factor of the collaboration itself.

In addition to shared understanding of goals, the interviewees also perceived shared understanding of processes as a success factor. A representative of a company involved in a University-industry partnership (C1) described the importance of shared understanding of goals and processes:

> *"One has to have understanding on what's being done. – [student projects] easily start going to a wrong direction, students get frustrated and the enterprise wonders [what went wrong]. Being interactive is a must." C1*

In this comment C1 illustrates that he perceives that being interactive leads to understanding, and by having understanding one can avoid situations where projects go to a "wrong direction, students get frustrated and the enterprise wonders [what went wrong]". Thus he perceives shared understanding of goals and processes as a success factor of mediated university-industry collaboration.

When asked for success factors of their collaboration, a manager involved in Research Collaboration (M10) emphasized the importance of shared understanding:

> *"-- mutual understanding, or common language. I don't mean Finnish or English, instead I mean, for example, can a master of arts talk with a master of science. -- [they] are able to talk together about same things, understand each other. It is of course one prerequisite for being able to transfer knowledge. – M10*

In this comment M10 show that he perceives shared understanding ("mutual understanding") as a success factor of mediated university-industry collaboration.

The comments presented in this subchapter illustrate how key personnel in mediated UI-collaboration perceive shared understanding of goals and processes as a success factor of mediated UI-collaboration. These perceptions are in line with existing literature (Gertner et al., 2011; Hughes et al., 2008).

4.4 Perception 4: Openness as a success factor

The interviewed key personnel in mediated university-industry collaboration perceived openness as a success factor of mediated university-industry collaboration. Based on our data analysis, the interviewees perception of openness is in line with Fontana et al. (2006) by including both being open to new knowledge and voluntarily disclosing knowledge. When asked about the risks of their collaboration with the intermediary organization, a company representative involved in a Start-up support organization (C13) compared the risks and benefits of openness in the following way:

> *"IPR, [and] leakage of business secrets. But on the other hand, it is very useful to openly spar one's own thoughts. There is trust, and currently no NDAs between start-ups". –C13*

In this comment C13 shows that he perceives openness as being useful enough to possibly outweigh the risk of leakage of business secrets. Representative of another company in another Start-up support organization (C12) had similar thoughts of openness:

> *I see a big problem in Finnish culture, the habit of not sharing. This is a wrong way to act, would be better to be as open as possible. Many are afraid that someone steals their idea. I would rather cooperate with a good idea than steal it. –C12*

In this comment C12 illustrates that he perceives openness as a success factor of mediated UI-collaboration by stating that culture, when talking in the context of UI-collaboration, should be more open. He also points out that in the context of start-ups the perceptions of openness as a success factor are controversial ("many are afraid that someone steals their idea"), but he perceives that the positive effects of openness outweigh the negative effects ("would be better to be as open as possible").

A manager of a University-industry partnership (M2) described openness as one of the aims of their intermediary organization:

> *Our aim is to create conversation and an open relationship of cooperation, where we understand their needs. –M2*

In this comment M2 illustrates that he perceives openness as one of the aims of his intermediary organization. As intermediary organizations' purpose in this context is to assist UI-collaboration (Yusuf, 2008), and M2 perceive openness as important enough to be the aim of the intermediary organization, M2 perceives openness as a success factor of mediated UI-collaboration.

The comments in this chapter illustrate that the interviewed key personnel in mediated UI-collaboration perceive openness as a success factor of mediated UI-collaboration, which is in line with existing literature (Fontana et al., 2006).

4.5 Summary

These four subchapters present the findings of analysis on key personnel's perceptions of success factors of mediated UI-collaboration. The analysis resulted in four key perceptions of success factors: (1) Networks as a success factor, (2) Knowhow and experience as success factors, (3) Shared understanding of goals and processes as a success factor, and (4) openness as a success factor. These findings are discussed in the next chapter.

DISCUSSION OF THE FIRST PHASE OF THE STUDY

5 Discussion: Key personnel's perceptions of success factors of mediated university-industry collaboration

The first phase of study probed success factors of mediated UI-collaboration in the context of Finnish intermediary organizations based on a data set of 34 interviews of key personnel in mediated UI-collaboration. This chapter presents an answer to the first research question, and discusses the contributions, credibility and implications for future research of the first phase of study (Chapter 4).

As is the nature of exploratory studies (Crouch and McKenzie, 2006), the first phase of study indicates rather than concludes. The findings of the first phase of study suggest four key perceptions of success factors of mediated UI-collaboration: (1) Networks (2) Knowhow and experience, (3) Shared understanding of goals and processes, and (4) openness. These four perceptions address the first research question: What do key personnel in mediated university-industry collaboration perceive as key success factors of their collaboration.

5.1 Theoretical implications

The first phase of study adds to scientific discussion on success factors of mediated UI-collaboration by probing their perceptions in the context of Finnish intermediary organizations. The novelty of the findings comes from the new dataset of 34 key people involved in mediated UI-collaboration and a rather new approach of managerial perceptions into success factors of mediated UI-collaboration. Even while the findings of the first phase are in line with existing literature of success factors of mediated UI-collaboration, it departs from it by its emphasis on perceptions. As such it could serve as a reference for researchers studying managerial perceptions of success factors of mediated UI-collaboration and related concepts.

As managerial perceptions impact decision making (Adner and Helfat, 2003; Snow, 1976), the findings on perceptions of success factors of mediated UI-collaboration suggest how perceptions of these factors could guide personnel in mediated UI-collaboration in their decision making.

If key people perceive *networks* as a success factor of mediated UI-collaboration, the decisions made in this collaboration might focus on creation of networks and this perception might create expectations for utilization of existing networks. If key people perceive *knowhow and experience* as a success factor of mediated UI-collaboration, their decisions might focus on e.g. training of key skills or validating the skills of potential partners before a collaboration. If key people perceive *shared understanding* as a success

factor of mediated UI-collaboration, their decisions might focus on implementing ensuring a consensus on processes and goals of the collaboration. If key people perceive *openness* as a success factor of university-industry collaboration, their decisions might focus on promoting open practices in their collaboration.

The theoretical priority of the findings of first phase of study is to work as a basis for the study on openness presented in the Publication, which provides the primary theoretical contribution of this thesis.

5.2 Practical Implications

The main practical value of the first phase of study is provided to people working in or interested in mediated university-industry collaboration in Finland. Understanding that the findings presented in this study are what people in mediated UI-collaboration may perceive success factors of their collaboration, and understanding that their perceptions affect their decisions (Adner and Helfat, 2003; Snow, 1976), the findings of phase one of this study assist both Finns and foreigners to better understand the decisions of key people in Finnish mediated university-industry collaboration. This is useful as existing literature has argued shared understanding to be a success factor of UI-collaboration (Gertner et al., 2011; Hughes et al., 2008).

The findings of phase one have been edited into a form more reachable to practitioners and presented in an illustrated guide "building bridges between universities and enterprises", which has been disseminated through the websites of Innovative City Program© and project Innopolis. The guide can be utilized by collaborators in mediated UI-collaboration to reflect their collaboration to these guidelines and find indications for improvement of their collaboration.

5.3 Evaluation and limitations of the study

The first phase of the study in this thesis studies key personnel's perceptions of success factors of mediated UI-collaboration through 34 semi-structured interviews. The second phase of this thesis studies managerial perceptions of openness in the same context through 11 semi-structured interviews of 13 managers. This chapter discusses the evaluation of the first phase of the study. The evaluation of the second phase of the study is discussed in the Publication.

When reality under examination consists of a set of multiple mental constructions as in a study of managerial perceptions, conventional justifications for evaluation of research are difficult to make use of (Lincoln & Guba, 1985). Lincoln and Guba (1985) propose a framework for evaluation of a qualitative study by defining four criteria to be used as cornerstones of evaluation: 1) credibility, 2) transferability 3) dependability and 4) confirmability.

Credibility (1) refers to the truthfulness of proposed causal relationships (Lincoln & Guba, 1985). In the context of the first phase of this study the credibility of causal relationships refers to the question whether the talk of interviewees coded as perceptions

of success factors actually represent perceptions of success factors. The issue of whether resulting perceptions of success factors actually promote success is outside the scope of this study, as this study concentrates on perceptions.

The credibility of the first phase of the study is challenged by the interpretation of the material, which is further complicated when all interviews were not conducted by the same interviewer. These particular risks in credibility are reduced in the second phase of study by limiting the data set to include only transcribed interviews in which the author of this thesis was present. Also, validity issues regarding interpretation are rather typical to exploratory studies and the value of these studies comes from their support to other researchers in the area (Crouch and McKenzie, 2006). All interpretations were checked by at least one other researcher. All interviews were semi-structured interviews involved the same set of questions, and all interviews were conducted in the context of Finnish intermediary organizations, which adds to the ability to make comparison between these interviews. The hypotheses were refined throughout the study, and previous stages of study affected the focus of the following stages.

Credibility can be enhanced by prolonged engagement (Lincoln and Guba, 1985). The author of this thesis was involved in the research of mediated university-industry collaboration for three years which contributed into learning of the culture and context of mediated university-industry collaboration.

Transferability (2) of a study evaluates whether the findings can be applied in other contexts and to other research subjects (Lincolnd and Guba, 1985). Threats to generalizability are a natural part of many studies, and should be noted when making judgements of transferability (Lincoln and Guba, 1985). The context of the study brings challenges to generalizability of the results, as it is possible the results are culture-specific and other collaborators in other countries perceive these success factors differently. Also, the non-manager interviewees were reached through the recommendations and contacts of managers of the 15 intermediary organizations in the data set. This brings forth the question whether these managers have chosen to guide the interviewers to collaborators that perceive success factors in a favorable way. However, this does not harm the purpose of this explorative study which is to find which kind of issues exist (Crouch and McKenzie, 2006).

Dependability (3), which refers to reliability, is evaluated by having a systematic, tracked and documented research process, which is depicted in this thesis. The decisions made throughout the study have been made transparent and could be tested by repetition of this research by another researcher (Lincoln and Guba, 1985).

Confirmability (4) refers to the objectivity of the study. The research was funded by non-profit EU-funded project Innopolis (Chapter 1.2.1), which seeks to find best practices for regional policy for innovation, and thus is interested in discovering the actual perceptions of success factors of mediated UI-collaboration. All findings have been discussed with

other researchers and the analysis has been made transparent in chapter 3 and 4 and in the Publication.

Lincoln & Guba (1985: 299) recommend questions are put to "nature itself" and it is "nature itself" that answers. When asking interviewees about the success factors of their collaboration, we didn't ask "nature" about success factors of mediated UI-collaboration, but we did ask "nature" about the interviewees' *perceptions* of these success factors. Thus the findings presented in this thesis are findings of *perceptions* of success factors (Chapter 4) and *perceptions* of openness (the Publication), not objective findings of actual success factors and openness.

The data set included in the first phase of study includes only two researchers, which might limit the validity of the study regarding perceptions of researchers. However, small qualitative data sets are good for exploring which kind of issues exist (Crouch and McKenzie, 2006). The value of exploratory research comes from its support to other researchers in the area (Crouch and McKenzie, 2006), which is elaborated in the next chapter.

5.4 Implications for future research

This study has probed perceptions of success factors only in the Finnish context. Future studies could address this limitation by probing perceptions in a similar fashion in other countries and compare how these perceptions relate to findings presented in this thesis. Future studies should also explore the differences in perceptions of different sides of the collaboration: are perceptions of e.g. company representatives critically different from those of intermediary organizations' managers, and if so, what do these differences in perception lead to?

To comprehend managerial perceptions in the context of this study, in addition to *what* factors are perceived as success factors of mediated UI-collaboration, *how* these factors are perceived is also important. The second phase of this study addresses this possibility for future research by probing one of these perceptions: openness. The second phase of this study is summarized in the next chapter and presented in the Publication.

6 Summary of the publication: Openness in university-industry collaboration, probing managerial perceptions

The first phase of empirical study found four common perceptions of success factors of mediated UI-collaboration in Finland: Networks, Knowhow and Experience, Shared understanding and Openness.

Even when openness is seen as a success factor in both the first phase of study (Chapter 4.4) and existing literature (Fontana et al., 2006), there seems to be little research indicating exactly *how* managers of intermediary organizations perceive the important concept of openness. The second phase addresses this need by focusing deeper into openness and answers the second empirical research question in this thesis: *How do*

managers of intermediary organizations in university-industry collaboration perceive openness?

Three criteria for data are set to form a final data set from the data used in the first phase of the study: (1) the interviewee is a manager involved in an intermediary organization, (2) the interview was transcribed, and (3) the author of this thesis was present in the interview. This second phase of research is presented in the Publication included in this thesis. The Publication addresses Openness as related to existing literature in the following way:

"Laursen and Salter (2004) discussed the concept of openness as the number of external channels firms can use to innovate. Fontana et al. (2006) built on this discussion and argued that "the concept of openness of a firm should be looked at from a broader perspective and may be considered as the set of activities carried out by firms to both gather information from and voluntarily reveal knowledge to the external world" (Fontana et al., 2006: 311). We build on Fontana et al.'s (2006) concept of openness by investigating how this concept of openness is perceived by managers of intermediary organizations in university-industry collaboration."

The Publication suggests a framework for managers' perceptions of openness in the context of mediated university-industry collaboration. The framework suggests four main ways managers perceive openness, which includes two perceptions of drivers of openness and two perceptions of what openness leads to (Figure 4).

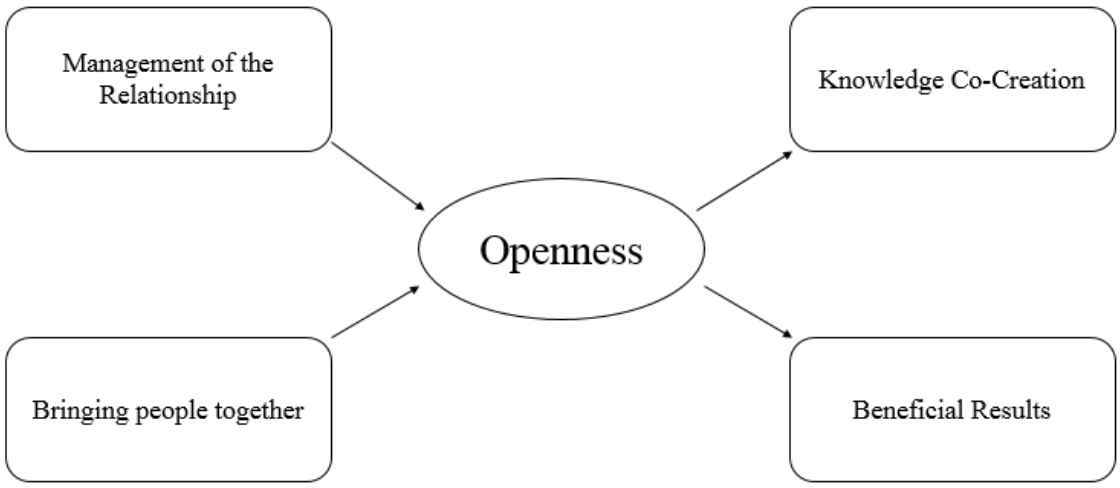

Figure 3: Framework of Managerial Perceptions of Openness

The first way is to perceive openness as driven by managing the relationship, which suggests managers can perceive openness as something that can be influenced by managing the relationships involved in the collaboration, such as investing in long-term collaboration. The second way suggests managers perceive openness as being driven by bringing people together, such as cherishing face-to-face meetings and building spaces where people can meet.

The third way suggests managers perceive openness as a driver of co-creation of knowledge. The fourth way suggests managers perceive that openness also supports other beneficial results of the collaboration, such as in a case where the benefits of sharing ideas in a business incubator was perceived to outweigh the risks of the business idea getting stolen.

For full details and discussion of the study of managerial perceptions of openness in mediated UI-collaboration, which forms the second part of the study in this thesis, please see the accepted version of the publication included in this thesis.

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APPENDICES

Appendix 1: Interview questionnaire

UNIVERSITY – COMPANY KNOWLEDGE EXCHANGE PRACTICES

Interview Schedule and Content

Subjects to be covered

1. General Questions

Name of institution of the interviewee	
Address	
Interviewee's name	
Interviewee's title	
Place	
Date	
Interviewer's name	

2. Description of the knowledge exchange practice

- Name of the practice?
- Main characteristics of the practice?
- How long has it been practiced by the organisation?
- How did this come about? Whose initiative was it?
- What prompted you (what are the key motivators – financial, knowledge, etc) to engage with knowledge exchange practice?
- Has your relationship with the other institutions evolved since then?
- How does the knowledge exchange practice take place in practice?
- How usual is this practice within the overall university-company cooperation?
- Is this the only one knowledge exchange that has taken place in your organisation?

3. Characteristics of the organisations (institutions) involved in the knowledge exchange

- Which university / company departments are involved?
- Does a person/department responsible for the KE (Knowledge exchange) exist within the interviewee organization?
- How many people are involved in this practice (how widely adopted is this)?
    - From the university
    - From the company
    - From other organisations

4. Type of knowledge transferred / exchanged

- Which is the direction of the knowledge transfer (university-> company, company->university, reciprocal)?

- Which is the type of knowledge transferred (formal, informal, technological, organisational)?

- Is the transferred knowledge interdisciplinary or does it belong to well defined fields of science or technology?

- How has this knowledge been created to the "broadcast" organisation?

- Does the recipient organisation have previous knowledge / know-how on the same subject?

5. Formal aspects of knowledge exchange

- Are there formal processes in the knowledge exchange practice? What are they?

- Does the exchange involve transfer of intellectual property?

- Are intellectual property agreements signed?

- How does the "broadcast" organisation secure its intellectual property?

6. Benefits of the knowledge exchange

- For the knowledge broadcast organisation

- For the knowledge recipient organisation

- Are these benefits measured? If so, what are the indicators?

7. Risks along the knowledge exchange

- For the knowledge broadcast organisation

- For the knowledge recipient organisation
- Is this practice expected to continue in the future?

8. Overall assessment

- How important is this practice for the organisation of the [interviewee]?
- Is it complementary to other knowledge exchange practices? If yes, which ones?
- How well is its importance recognised within the organisation?

9. Key success/failure factors & policy for the knowledge exchange

- Based on your experience, what are the key success/failure factors for this knowledge exchange practice?
- How does your organisation encourage such knowledge exchange practices?
- When engaging in knowledge exchange, have you gained benefit from any policy measures/incentives at the EU, national or regional level?
- What are the most important barriers for cooperation?

SECOND PHASE OF THE STUDY

Publication

Moilanen, H., Halla, M., Alin, P., (Forthcoming). Openness in University-Industry Collaboration: Probing Managerial Perceptions. *European Journal of Innovation Management.* Doi: 10.1108/EJIM-05-2013-0048

Openness in university-industry collaboration: probing managerial perceptions

1 Introduction

New knowledge creation is a key antecedent of innovation, which is a key driver of economic growth of nations and regions (Agrawal, 2001; Dossou-Yovo and Tremblay, 2012; Hine et al., 2010). Researchers have argued that university-industry collaboration is a powerful mechanism for new knowledge creation (Bercovitz and Feldman, 2007; Bishop et al., 2011; D'Este and Patel, 2007; Yusuf, 2008). University-industry collaboration refers to collaboration between universities and firms that is intended to generate and/or diffuse innovations. University-industry collaboration tends to include a two-way flow of knowledge, as both parties can be interested the knowledge the other (Meyer-Krahmer and Schmoch, 1998).

In the context of university-industry collaboration, knowledge creation can be promoted by designating specific organizations to mediate the collaboration (Etzkowitz and Leydesdorff, 2000; Yusuf, 2008). Building on a long tradition of research on networks (e.g. Argote and Ingram, 2000; Zucker et al., 1988), researchers have identified that such intermediary organizations in university-industry collaboration can increase new knowledge creation by facilitating the collaboration among the participating individuals and organizations (Wright et al., 2008; Yusuf, 2008).

In addition to the role of intermediary organizations (Yusuf, 2008), researchers have acknowledged the importance of openness of the relationships among participants in university-industry collaboration (Fontana et al., 2006). Fontana et al. (2006) define openness as "the broad set of activities that firms can conduct to acquire knowledge from, voluntarily disclose knowledge to and/or exchange knowledge with the external world".

Despite the importance of openness in university-industry collaboration and the importance of intermediary organizations in that same context, there appears to be little research indicating how managers in mediated university-industry collaboration might perceive the concept of openness. This lack of research is understandable given that it is difficult to collect data on managerial perceptions (Starbuck and Mezias, 1996). At the same time, the lack of research is problematic: because individuals make decisions based on their perceptions (Miles and Snow, 1986), the way in which intermediary organizations' managers and other personnel perceive the concept of openness impacts how they make decisions about it. In this exploratory paper we address this lack of

research by probing how intermediary organizations' managers' perceive the concept of openness in the specific context of university-industry collaboration.

2 University-industry collaboration as an innovation generation mechanism

The generation of innovations is a vital driver of economic growth of nations (Hine et al., 2010; Kodama, 2008). Generating innovations is not enough, however: economic growth of nations also requires the diffusion of generated innovations as well as the formation of mechanisms that generate innovations on a regular basis (Hine et al., 2010). Still, developing such mechanisms is challenging (Kodama et al., 2008).

Knowledge is a fundamental resource and a major element for innovation and the competitiveness of firms, regions and nations (Dossou-Yovo and Tremblay, 2012). The two-way collaboration between universities and businesses is an important source of new knowledge that can lead to commercial innovation (Bishop et al., 2011; Debackere and Veugelers, 2005; Meyer-Krahmer and Schmoch, 1998; Yusuf, 2008). According to Agrawal (2001: 285) it is "commonly accepted that universities are an important source of new knowledge."

In addition to being an important source of new knowledge, universities can also help in diffusing innovations. Mansfield (1998) found that without academic research over 10% of new product introductions in his data would not have been developed on time. Bishop et al. (2011) also point out that university research contributes to industrial innovation. Thus, it appears that university-industry collaboration can be an important mechanism that can generate innovations on a regular basis. We define university-industry collaboration as collaboration between universities and firms with the intention of generating and/or diffusing innovations.

2.1 Intermediary organizations

The need to support innovation through university-industry collaboration has given rise to a novel set of intermediary organizations intended to facilitate this collaboration. Intermediary organizations in university-industry collaboration are organizations that act between organizations coming from these rather different worlds (Wright et al., 2008). Howells (2006: 720) defined an intermediary organization as "*an organization or body that acts [as] an agent or broker in any aspect of the innovation process between two or more parties."* Howells (2006) also introduced several possible activities that intermediary organizations can take part in, e.g. providing information about potential collaborators, brokering transactions between parties, and helping to find advice, funding and support for the collaboration.

University-led business incubators or partnership programs are typical examples of intermediary organizations in the context of university-industry collaboration. Moreover, as Howells (2006) and Yusuf (2008) point out, many types of intermediary organizations often work in concert. Intermediary organizations have an important role in facilitating the links between universities and industry (Acworth, 2008; Wright et al., 2008) because they can provide resources that the members of the collaboration cannot or are unwilling to provide (Johnson, 2008). Building on earlier research (Bessant and Rush, 1995; Howells, 2006), Yusuf (2008: 1170) argued that intermediary organizations are useful because they assist in exchanging knowledge between universities and firms by:

> "*bridging ties and interfaces, by diagnosing needs and articulating the demand for certain kinds of innovation, by instituting a dynamic framework for change and working to achieve the change through financing and other means.*"

Likewise, intermediary organizations have been seen to advance innovation in university-industry collaboration (Klerkx and Leeuwis, 2009; Kodama, 2008; Wright et al., 2008; Yusuf, 2008) by bridging and brokering roles between different types of actors. Such intermediation is especially important when the knowledge is tacit (Kodama, 2008; Yusuf, 2008) or when there is a large physical or cultural distance (Kostova and Roth, 2003), which is the case in university-industry collaboration (Lee, 1995).

2.2 Openness

The effective operation of intermediary organizations in university-industry collaboration requires a certain level of openness from the firms and the university partners. Laursen and Salter (2004) discussed the concept of openness as the number of external channels firms can use to innovate. Fontana et al. (2006: 311) built on this discussion and argued that researchers should examine the concept of openness more widely, as "the set of activities carried out by firms to both gather information from and voluntarily reveal knowledge to the external world."

Fontana et al. (2006) found that firms' openness to the external environment has an important effect on their collaboration with public research organizations. These authors further defined openness as "the broad set of activities that firms can conduct to acquire knowledge from, voluntarily disclose knowledge to and/or exchange knowledge with the external world" (Fontana et al. 2006: 310). They also claimed that openness is "very important in explaining their [firms] patterns of collaboration with PROs [public research organizations]" (Fontana et al, 2006: 321).

2.3 Intermediary organizations' managers' perceptions of openness

Managers are in the business of making decisions concerning how organizations deal with the external environment (Lawrence and Lorsch, 1967). The quality of managers' decisions depends, at least partially, on how managers perceive the organization's

environment (Adner and Helfat, 2003). Especially models of rational decision-making suggest that "accurate perceptions increase decision quality" (Weick et al., 2005: 415). A potential theoretical mechanism behind this argument is that because managers respond only to events and phenomena they can perceive (Snow, 1976), the way in which managers perceive key phenomena impacts their decisions.

This paper is based on the premise that openness is a key phenomenon in the context of university-industry collaboration (Fontana et al., 2006), and on the premise that managers perceive primarily only "those aspects of the situation that relate specifically to the activities and goals" of their departments and organizations (Dearborn and Simon, 1958:140). Based on these premises, we argue that how managers of intermediary organizations in university-industry collaboration perceive "openness" impacts their decisions concerning how the intermediary organizations respond to events in their environment. However, despite the seeming importance of intermediary organizations' managers' perceptions of their organizations' external environment, there seems to be little empirical research on how intermediary organizations' managers perceive the key concept of openness. We address this limitation by asking *how managers of intermediary organizations in the context of university-industry collaboration perceive the concept of openness.*

3 Methods and data

To address the research question, we chose a qualitative analysis strategy that enabled us to analyze how managers perceive openness by observing how they talk about their organizations during in-depth interviews (Robson, 2002). This strategy is based on the assumption that individuals' perceptions can be observed via in-depth interviews (Crouch and McKenzie, 2006). To collect a data set that would enable us to observe intermediary organizations' managers' talk on openness in the context of university-industry collaboration, we negotiated access to 20 Finnish intermediary organizations involved in university-industry collaboration. The intermediary organizations were involved in university-industry collaboration in the following ways: Research Collaboration (e.g. partially industry funded applied research labs); University-Industry (UI) partnerships (e.g. personal networking support organizations); and Start-Up Support organizations (e.g business incubators).

To observe managerial talk on openness, we interviewed 13 managers from these 20 intermediary organizations. These interviews were conducted in 2010 as a part of a bigger interview round of 34 interviews of managers, company representatives and other people in university-industry collaboration. In the interviews we asked the managers questions such as *What does your organization do?; What, in your opinion, are the key factors of success for this kind of knowledge exchange collaboration?* and *What are the possible key factors of failure for this kind of knowledge exchange collaboration?* We present an example of the interview questionnaire in Appendix 1.

All interviews were semi-structured, took about one hour and were held with individuals face-to-face. In the semi-structured interviews we started with a pre-specified set of questions but remained open to ask additional questions based on how the interview proceeded (Myers and Newman 2007). We recorded all interviews with digital recorders. Ten interviews were attended by one manager and one interview was attended by three managers from the same organization. The resulting final dataset consists of 11 interviews of 13 managers from nine different intermediary organizations in the context of university-industry collaboration. Four of these interviews were from intermediary organizations related to Research Collaboration; five to Start-Up Support organizations; and two to University-Industry partnerships. Crouch and McKenzie (2006) argue that a small number of respondents is a reasonably good way to conduct analytic, inductive and exploratory studies. We contend that our data set consisting of 13 managers is sufficient for our exploratory study on intermediary managers' perceptions on openness.

The interviews were analyzed following the comparative qualitative analysis method (Glaser and Strauss, 1967: 105-115). After transcribing the recorded interviews we began to code the interviewees' comments. In coding, we used the Atlas.ti qualitative data analysis software package. First, to gain a good preliminary understanding of the data, we began by coding the interviewees' comments with data-based codes, e.g. *networks*, *resources*, *systemacy*, *team*, *commitment*, *flow of information and communication*, *shared understanding of goals*, *know-how*, *experience*, and *openness*. Beginning the coding process with data-based codes – a practice called *open coding* (Corbin and Strauss 1990) – is useful because it enables the researcher to develop early analytical insight on the phenomenon of interest.

Then, to gain a good understanding of how the managers talked about openness, we focused our coding efforts on the codes coded "openness." Many comments in which interviewees talked about openness without using the specific term "openness" were included in the coding as we felt these comments expressed "openness" in some way. To be able to sufficiently describe all "openness" comments in the data, we then coded the "openness" comments with additional labels that emerged from the data, e.g. *openness enhances business ideas; openness is enhanced by continuity; openness is enhanced by commitment; openness is enhanced by rules and systemacy;* and *openness is important*. These additional labels, in essence, depict the observed subcategories of "openness" in the interviewees' talk. The practice of coding the concept of "openness" into subcategories resembles what Corbin and Strauss (1990) called *axial coding*.

Finally, based on our open coding and axial coding efforts, we identified four higher-level categories (Gioia et al. 2013) of managerial openness perception: 1) Openness as driven by management of the relationship (16 comments); 2) Openness as driven by bringing people together (10 comments); 3) Openness as a driver of co-creation of knowledge (13 comments); and 4) Openness as a driver of beneficial results (18 comments). In Table 1

we present how we categorized the managers' comments from different types of intermediary organizations to these four categories

Table 1: Categorization of comments

Interviewed manager	Type of intermediary organization	Management of the relationship	Bringing people together	Co-creation of knowledge	Beneficial Results	Quotes related to openness
M1	Research Collaboration	2	2	4	6	8
M2	UI Partnerships	1	1	1		3
M3	Research Collaboration	2	1	1	1	5
M4	Research Collaboration	2	1	1	1	3
M5	Start-up support organization	2	1	2	5	5
M6	Start-up support organization		1			1
M7	Start-up support organization	2		1	2	3
M8	UI Partnerships	3	1			4
M9	Start-up support organization	1	1	1	3	6
M10	Start-up support organization	1				1
M11	Research Collaboration		1	2		2

4 Managerial perceptions of openness

Through our coding efforts four categories of managerial perceptions of openness emerged: (1) Openness as driven by management of the relationship; (2) Openness as driven by bringing people together; (3) Openness as a driver of co-creation of knowledge; and (4) Openness as a driver of beneficial results.

1. Openness as driven by the management of the relationship

The interviewed managers perceived that openness is driven by proper management of the collaborative relationship between universities and firms. Based on our data analysis, proper management of the relationship includes establishing long-term relationships among individuals and/or organizations in the university-industry collaboration. Proper management of the relationship also includes establishing proper rules and agreements to govern the relationship. A manager involved in a Research Collaboration (M3) stated that these agreements should have room for maneuvering to maintain openness:

> *"Agreements should be made in a reasonable way, in a way that they advance that collaboration, not hinder it. If there is an agreement that's too tight, so that everything is defined, I won't dare to open my mouth because I have to browse through the agreement all the time." -M3*

In this comment M3 illustrates that he perceives agreements to have a noticeable effect in openness in the collaboration: too tight agreements prevent openness *("---I won't dare to open my mouth").* This manager also stated that when agreements are "made in a reasonable way," they can enhance collaboration. This manager perceives that reasonable agreements involve openness, because an unreasonable agreement is "an agreement that's too tight, so that everything is defined.*"* Another manager involved in a University-Industry partnership (M8) described the importance of establishing long-term relationships in university-industry collaboration:

> *"Continuity [is important in collaboration], there shouldn't be just single projects--- Trust comes from continuous collaboration and the concrete results it leads to." – M8*

This manager's comment stressing continuity suggests that he perceives long-term relationships as a driver of trust. As trust indicates willingness to have openness (Lin, 2006), this manager appeared to perceive long-term relationships as an antecedent of openness. Similarly linking trust and openness, a manager involved in a start-up support organization (M7) illustrated the importance of establishing proper rules as a factor behind openness:

> *"Innovation activity is based on trust. Trust demands transparency and clear rules of the game, which are communicated properly." –M7*

Following Lin (2006) in linking trust with openness, we interpreted this manager's comment indicating that he perceived a connection between openness and proper rules ("*trust demands --- clear rules of the game"*). The formal part of these rules in this case was non-disclosure agreements signed by the parties of the collaboration. Taken together, these observations suggest that managers of intermediary organizations perceive that openness is driven by the proper management of the collaborative relationship (i.e. establishing long-term relationships and proper rules and agreements.)

2. Openness as driven by bringing people together

The interviewed managers perceived openness as driven by bringing people together and enabling them to talk face-to-face. Many managers perceived bringing people together to be one of the main purposes of their intermediary organization. A manager of a Start-Up Support organization (M6) described the importance of providing a common physical space:

> *"This is a place to meet, a home for entrepreneurs, and we perceive that it is extremely important that we have a kind of a place for sharing culture and knowledge of entrepreneurship, where people come across, meet each other, learn and can work." –M6*

In this comment M6 explicitly stated that he perceives that people meeting each other is vital to sharing knowledge, and such meetings can be supported by offering physical meeting places. Likewise, another manager of a Start-Up Support organization (M9) stated that opening up, mixing and matching people makes the most important core of their operation:

> *"Definitely no collaboration happens if there isn't any kind of networking and opening up and, kind of, increasing knowledge and mixing up and matching. [We] have to be able to go there [to the university] and get people from there to come here. There has to be some of this mixing up, so to say. Kind of, that's probably the core of everything.*" –M9

This comment by M9 further illustrates how the managers perceived that meeting face-to-face is important ("[*We] have to be able to go there [to the university] and get people from there to come here"*) because it contributes to voluntarily disclosing knowledge ("*opening up and, kind of, increasing knowledge"*). The manager saw that opening up, mixing up and matching are activities supporting voluntary, informal exchange of knowledge, and thus supporting openness. As Fontana et al. (2006) have also suggested that openness involves voluntarily disclosing knowledge, we argue that the intermediary organizations' managers perceive that voluntarily disclosing and sharing knowledge is a form of openness.

The importance of bringing people together was described by other managers as well. A manager involved in a University-Industry partnership (M8) described the importance of being able to meet and have constructive discussion on a neutral ground:

> *"[One knowledge exchange success factor is] the ability to discuss with different parties [from universities and firms] and recognizing interests --- the diplomatic facilitation of this knowledge exchange is vital, so that we find the parties of interest that can meet on neutral ground and be able to build a common agenda. It requires a lot of work and knowledge, who can have a discussion in a constructive spirit and how we get to practice from there." –M8*

In this comment M8 perceives it as important that the parties of the university-industry collaboration can meet and exchange knowledge on neutral ground, and that it is useful to facilitate this knowledge exchange. He also described that it is important to be able to have a "discussion in a constructive spirit" – so important, in fact, that it can be a basis for choosing the partners. Since a part of constructive discussion is to be able to give opinions and to be open to suggestions, this comment illustrates how managers perceive that open discussion is vital to the success of the knowledge exchange practice, and being able to meet on neutral ground can support openness.

Taken together, these observations suggest that managers in intermediary organizations perceive that openness involves bringing people together.

3. Openness as a driver co-creation of knowledge

The interviewed managers perceived openness as a driver of co-creation of knowledge. A manager involved in a University-Industry partnership (M2) described the connection between openness and new knowledge creation as follows:

> *"So we create that knowledge together which then… to produce new knowledge and understanding together, kind of like this. Kind of just that, that to listen to each other." –M2*

This comment illustrates that M2 perceives how openness ("*to listen to each other"*) leads to co-creation of new knowledge. New knowledge creation is one of the main goals of intermediary organizations (Yusuf, 2008), and the managers in our data perceived supporting openness as one of the methods for new knowledge creation. For example a manager of a University-Industry partnership (M4) described:

> *"We make different kinds of events in which people would meet and new ideas would be born, which can be presented in research idea search. --- A platform for people to meet and to build trust, we can build new [ideas] together and take things forward." –M4*

In this comment M4 described how people meeting in events leads to new knowledge creation. By perceiving openness as having people meet each other, M4 perceives that openness is a driver of co-creation of knowledge by the university-industry collaboration participants. He also points out that one mediating factor is trust, which Lin (2006) stated to be related to openness. These observations illustrate how the managers in intermediary organizations perceive openness as an antecedent of co-creation of new knowledge.

4. Openness as driver of beneficial results

The interviewed managers perceived that openness provides beneficial results for the collaborators. A manager of a Research Collaboration (M1) stated the importance of openness to beneficial results in a very explicit way:

> *"If our partners in the collaboration are not open enough themselves, [then] there's the risk that they don't gain any benefits out of it. They don't get the gains, [or the] potential to their disposal, which would come from making use of the competence of others." –M1*

This comment from M1 illustrates his perception that without openness there are likely no beneficial results for the collaboration participants as "*[t]hey don't gain any benefits."* The comment also elaborates his perception that the collaboration participants who are open benefit from their openness. Likewise, a manager involved in a Research Collaboration (M3) illustrated how he perceived that openness can be beneficial to all parties of the collaboration:

> *"We get our hands on the actual data of firms, even close to their business secrets. So, we conduct research with firms, municipalities and other parties, develop their operational models and gain research data for our own research projects, doctoral theses [and] publications. Firms gain benefits for themselves." –M3*

In this comment M3 states that it is beneficial for all parties when the companies are open to the extent that they let the university personnel get "hands on the actual data of firms." Openness was perceived as beneficial in the context of Start-Up Support organizations, as a manager involved in one such organization (M5) illustrated:

> "*We are a very open community. We talk a lot, share ideas and discuss them so that they would get better. There's the risk that it leaks and gets, so to say, stolen somewhere. That's how it goes in a competitive world. We put, for example, videos on the internet; someone can steal them for themselves. It only proves that the idea is good, you just have to do it better than the other one." -M5*

In this comment M5 explicitly stated how openness ("*We talk a lot, share ideas and discuss them"*) is beneficial for firms by making their ideas better. This manager also perceived openness as beneficial enough to outweigh the risk of getting ideas stolen.

These observations illustrate how the managers in intermediary organizations perceive openness leading to beneficial results for all parties involved.

5 Discussion

Openness has been shown to be a vital factor in the success of university-industry collaboration (Fontana et al., 2006), which is a key driver of knowledge creation (Bercovitz and Feldman, 2007; Bishop et al., 2011; Yusuf, 2008). Knowledge creation, in turn, leads to innovation and economic growth (Agrawal, 2001; Dossou-Yovo and Tremblay, 2012; Hine et al., 2010). In addition to openness, also intermediary organizations have been found to enhance university-industry collaboration (Yusuf, 2008). Our study addresses the apparent lack of research on how openness is perceived by managers in the context of university-industry collaboration that is mediated by intermediary organizations.

The primary objective of this study was to increase our understanding of how managers of intermediary organizations in the context of university-industry collaboration perceive openness. To attain this objective, we analyzed managerial talk from 11 semi-structured interviews of 13 managers of intermediary organizations. As is the nature of exploratory studies (Crouch and McKenzie, 2006), our research indicates rather than concludes. Our findings suggest that intermediary organizations' managers can perceive openness in four distinct ways: (1) Openness as driven by management of the relationship, (2) Openness as driven by bringing people together, (3) Openness as a driver of co-creation of knowledge and (4) Openness as a driver of beneficial results. Based on these findings we suggest a framework of managerial perceptions of openness. Following McKinley et al. (1999) we understand 'framework' as a conceptual devise for organizing empirical observations using theoretical terms. As such, our framework is explicitly aimed at linking our empirical findings to extant research.

5.1 A framework of managerial perceptions of openness

Laursen and Salter (2004) discussed the concept of openness as the number of external channels firms can use to innovate. Fontana et al. (2006) built on this discussion and argued that "the concept of openness of a firm should be looked at from a broader perspective and may be considered as the set of activities carried out by firms to both gather information from and voluntarily reveal knowledge to the external world" (Fontana et al., 2006: 311). We build on Fontana et al.'s (2006) concept of openness by investigating how this concept of openness is perceived by managers of intermediary organizations in university-industry collaboration.

The managers in our data perceived that openness can be supported by how the intermediary organization manages its relationships (e.g. contracts, agreements, supporting continuity and inter-organizational practices). We termed this finding

*Openness as driven by management of the relationsh*ip. As managers' perceptions impact their decision-making (Adner and Helfat, 2003), our finding suggests that the way in which managers perceive the concept of openness might impact their decisions concerning the management of their collaborative relationship. This suggestion is in line with Fontana et al.'s (2006) statement that openness has an important effect on the development of university-industry collaboration.

Second, the managers in our data perceived that openness can be enhanced by bringing people together, e.g. for face-to-face discussions. We termed this finding *Openness as driven by bringing people together*. In their study Bruneel et al. (2010) emphasized the importance of face-to-face discussions in university-industry collaboration. Since openness is an important factor in university-industry collaboration (Fontana et al. 2006), our findings of managers' perception of the importance of face-to-face discussion to openness are in line with Bruneel et al.'s (2010) findings. Face-to-face discussions have also been studied by Hardwick et al. (2013). These authors stated that face-to-face discussions are important in building trust (Hardwick et al., 2013). Since trust indicates willingness to have openness (Lin, 2006), our findings are in line with Hardwick et al. (2013).

Third, the managers in our data perceived openness to be a vital factor of co-creation of knowledge. We termed this finding *Openness as a driver of co-creation of knowledge*. Since university-industry collaboration is an important mechanism for creating new knowledge (Yusuf, 2008), this finding further supports Fontana's (2006) statement of the importance of openness in university-industry collaboration.

Fourth, the managers in our data perceived that openness leads to beneficial results. We termed this finding *Openness as a driver of beneficial results*. This finding supports Fontana et al.'s (2006) argument of openness as an important concept in university-industry collaboration. Overall, our four findings constitute an exploratory framework of managerial perceptions of openness. The framework suggests that how managers perceive openness is, by and large, in line with how researchers have discussed openness.

5.2 Contributions

Contributions to discussions on managerial perception of openness

Previous researchers (e.g. Fontana et al. 2006; Laursen and Salter, 2004) have discussed the important concept of openness without venturing into how the concept might be perceived by practicing managers. While our results are by and large in line with this previous research, we depart from it by identifying four distinct ways in which managers can *perceive* openness in the university-industry collaboration context. As such our framework could help researchers to further open the proverbial black box of "managerial perception of openness" and related concepts. Even if the specific findings behind the

framework of managerial perceptions of openness might be applicable mainly in the specific context of intermediary organizations, we argue that they nonetheless provide a good starting point for future research on managerial perceptions of openness.

Contributions to discussion on decision-making

Since managerial perceptions impact decision making (Adner and Helfat, 2003; Snow, 1976), our framework of managerial perceptions of openness offers some suggestions on how perceptions of openness might guide the decision making of managers of intermediary organizations.

If managers perceive openness as *driven by* the management of the relationship (e.g. as proper rules and agreements), their decision-making might focus on rules and agreements when they want to promote openness. If managers perceive openness as *driven by* bringing people together (e.g. in the form of face-to-face discussions), their decision-making might instead focus on promoting face-to-face discussions when they want to promote openness.

On the other hand, if managers perceive openness as *a driver* of co-creation of knowledge, their decision-making might focus on enhancing openness when they want to enhance co-creation of knowledge. If managers perceive openness as *a driver of* beneficial results for collaboration, their decision-making might focus on enhancing openness when they want to enhance collaboration.

Contributions to discussions on intermediary organizations

The extant literature has presented a number of success factors of intermediary organizations, such as absorptive capacity (Kodama, 2008), common language (Gertner et al, 2011), expertise (Suvinen et al., 2010; Wright et al., 2008) and trust (Suvinen et al., 2010). Despite these studies, and despite Fontana et al's (2006) research on openness and Yusuf's (2008) research on intermediary organizations, there appears to be little integrative research on whether openness might be a potential success factor of intermediary organizations. Beginning to address this research gap, our findings imply that openness might be an important factor of success for intermediary organizations in university-industry collaboration. Since the managers in our data perceive that openness is useful (as it enhances beneficial results and co-creation) and is worth supporting (as their willingness to support openness affects how they manage their intermediary organizations), more attention should be given to openness as a success factor of intermediary organizations, especially in university-industry collaboration.

Contributions to practice

Our findings provide useful guidance to managers of intermediary organizations and other partners in mediated university-industry collaboration by providing better understanding on the important concept of perception of openness in that context.

Understanding how managers in intermediary organizations perceive openness can offer guidelines for people who collaborate with them.

Our findings suggest that people working in the context of mediated university-industry collaboration should pay attention to how openness is perceived by their collaborators because perceptions can differ. According to our framework, managers and other partners in university-industry collaboration may perceive they can support openness by properly managing the relationship (e.g. reasonable agreements, continuous collaboration) or by bringing people together. Also according to our framework, managers and other partners in university-industry collaboration may perceive that openness is a driver of co-creation of knowledge or beneficial results more broadly. Thus managers and other partners in university-industry collaboration should put forth effort to understand how people around them perceive the concept of openness.

5.3 Limitations and future research

One limitation of our study is our relatively small data set. However, as Crouch and McKenzie (2006) argue, even a relatively small qualitative data set can be sufficient in discovering what kinds of issues exist. According to these authors, for exploratory, concept-generating studies like ours it is reasonable to have a small sample size (Crouch and McKenzie, 2000). Also, as it is generally difficult to collect data on managerial perceptions (Starbuck and Mezias, 1996), we argue that our data set can offer some important early insight to how managers perceive the concept of openness.

In addition, a potential limitation of our study, and other exploratory studies like ours (Crouch and McKenzie, 2006), includes validity issues relating to the interpretation of the interview material. Openness in itself is a complicated concept, which can be interpreted in a number of ways. Further complicating the matter of interpretation, openness can be interpreted either as being open to external knowledge (“outside-in”) or disclosing one’s knowledge to others (“inside-out”) (Chesbrough, 2012:21). Our interpretation in this study includes both outside-in and inside-out aspects. This interpretation choice was borne out of the data analysis as we discovered that the managers in the data perceived openness in both ways.

Crouch and McKenzie (2006) remind that the value of exploratory research comes from its role as support for other researchers of the area. Future research should study whether differences in openness perception exist among different contexts of university-industry collaboration, among different countries, or among personnel in different roles. Also the link between managerial perceptions of openness and managerial decision-making should be studied more directly. We also suggest that a comparative study should be conducted by directly asking interviewees about their opinions of openness and compare the results to the ones presented in this study.

6 Conclusions

This study provides a framework for managers' perception of openness in the context of mediated university-industry collaboration. The framework implies that managers can perceive openness as (1) driven by managing the relationship and (2) driven by bringing people together. The framework also implies that managers can perceive openness as (3) a driver of co-creation and as (4) a driver of beneficial results. Our findings can be used to better understand the decision making of the managers of intermediary organizations. Researchers constructing models for decision making of managers of intermediary organizations can use our framework to investigate how the managers make decisions under different perceptions of openness. The managers themselves and their partners in university-industry collaboration can make use of our study as a set of guidelines on how to relate to openness in their collaboration.

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